Series 1958, No. 13

Issued October 1961

SOIL SURVEY

Stevens County Kansas

OUR SOIL ★ OUR STRENGTH

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
KANSAS AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY was made to find out the nature and extent of each kind of soil in Stevens County. In making this survey, soil scientists dug holes and examined surface soils and subsoils in cultivated fields and native grasslands. They measured slopes with a hand level; observed differences in the growth of crops, weeds and grass; and, in fact, recorded all the things about the soils that they believed might affect their suitability for farming and related uses.

The soil scientist placed the soil boundaries on aerial photographs. Then, cartographers prepared from the photographs the detailed soil map in the back of this report.

Locating the soils

Use the index to the map sheets to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. When you locate the correct sheet of the large map, note that the boundaries of the soils are outlined and there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map. The symbol will be inside the area if there is enough space; otherwise, it will be outside the area and a pointer will show where it belongs.

Suppose, for example, an area located on the map has the symbol Rm. The legend for the detailed map shows that this symbol identifies Richfield silt loam, 0 to 1 percent slopes. This soil and all others mapped in the county are described in the section "Descriptions of the Soils."

Finding information

Few readers will be interested in all of the soil survey report, for it has special sections for different groups, as well as sections that may be of value to all.

Farmers and ranchers can learn about the soils in the section "Descriptions of the Soils," and then they can turn to the section "Use and Management of the Soils." In this way they first identify the soils on their farm, and then they learn how these soils can be managed.

The soils are placed in capability units; that is, groups of soils that need similar management and respond in about the same way. For example, in the section "Descriptions of the Soils," Richfield silt loam, 0 to 1 percent slopes, is shown to be in capability unit IIIc-1 for dryland farming and in capability unit I-1 for irrigation farming. The management suitable for this soil, therefore, will be described under the headings "Capability Unit IIIc-1" and "Capability I-1 (Irrigated)" in the section "Use and Management of the Soils."

For the convenience of those who manage rangeland, the soils are placed in range sites. Each range site has a given potential production of grasses and other vegetation. For example, Otero fine sandy loam, 5 to 12 percent slopes, is placed in the Sandy range site. Each range site is described in the section "Range Management."

The "Guide to Mapping Units, Capability Units, and Range Sites" at the back of the report is provided to simplify use of the map and the report. With it, the reader can locate the description of each soil shown on the map, as well as the description of the capability unit and range site in which it has been placed.

Soil scientists will find information about how the soils were formed and how they are classified in the section "Genesis and Morphology of the Soils."

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending on their particular interest.

Newcomers in Stevens County will be especially interested in the section "General Soil Areas," which describes the broad pattern of the soils. They may also wish to read the section "General Nature of the County," which gives additional information about the county.

* * *

To provide a basis for agricultural use of the land, this cooperative soil survey was made by the United States Department of Agriculture and the Kansas Agricultural Experiment Station. Fieldwork was completed in 1958, and, unless otherwise specified, all statements in this report refer to conditions at that time.

This survey is a part of the technical assistance the Soil Conservation Service furnishes to the Stevens County Soil Conservation District, which was established in 1949. The governing board of that district arranges for technical assistance from the Soil Conservation Service and provides leadership in the countywide program for conserving soil and water. If you want help in farm or ranch planning, consult the local representative of the Soil Conservation Service or the county agricultural agent.

U.S. GOVERNMENT PRINTING OFFICE: 1961

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

Contents

Growth Through Agricultural Progress

Series 1958, No. 13

Issued October 1961

SOIL SURVEY OF STEVENS COUNTY, KANSAS

BY HAROLD P. DICKEY, A. A. EEDS, AND L. A. HECHT, SOIL CONSERVATION SERVICE[1]

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE KANSAS AGRICULTURAL EXPERIMENT STATION

STEVENS COUNTY is in the southwestern part of Kansas. It is bordered on the south by Oklahoma. The air mileage from Hugoton, the county seat, to Topeka, the State capital, and to other towns and cities is shown in figure 1. The area of the county is 729 square miles, or 466,560 acres.

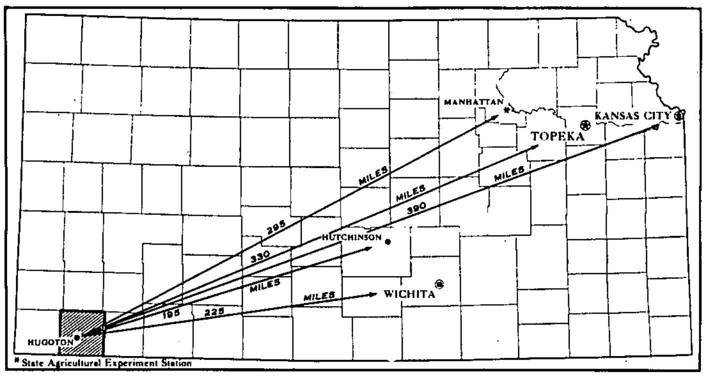


Figure 1.—Location of Stevens County in Kansas.

Stevens County is important for the production of grain sorghum. Wheat is also a main crop. The county has a semiarid climate, and wind erosion is the chief hazard in farming. The production of natural gas is the principal nonagricultural industry.

General Soil Areas

The soils of Stevens County occur in several definite patterns, each related to the topography, or lay of the land. In each of these patterns, certain soils or associations of soils are dominant. The patterns are known as general soil areas or, as they are sometimes called, soil associations. The general soil areas of Stevens County are shown in figure 2.

The map showing general soil areas is useful to those who want a general idea of the soils, who want to compare different parts of a county, or who want to locate large areas suitable for some particular kind of agriculture or other broad land use.

1. Vona-Tivoli (Sandhills)

The Vona-Tivoli soil association, locally called sandhills, covers about 30 percent of the county. It occurs in all parts of the county except the northeastern. It is composed mainly of sandy soils. The soils occupy rolling and hilly areas (fig. 3).

The principal soils in this association are the Vona and Tivoli. Vona loamy fine sands are the most extensive and occupy the rolling areas. Tivoli soils are sandier than the Vona soils and occupy the hilly areas.

The soils are not well suited to crops. Nevertheless, about 60 percent of the acreage is used to produce crops, mainly sorghum. The rest is used for pasture.

The soils of this association are very susceptible to wind erosion if they are not protected by vegetation. They also have low moisture-holding capacity.

2. Colby-Otero-Lincoln (Cimarron River Valley)

This soil association covers about 3 percent of the county. It occupies the slopes and flood plains along the Cimarron River and its tributaries.

The association is composed of the following: Colby soils, 35 percent; Otero soils, 44 percent; Lincoln soils, 14 percent; and the Cimarron River, 7 percent. The Colby and Otero soils occupy moderately steep slopes. The Lincoln soils are on the flood plain along the Cimarron River.

The soils of this association are best suited to pasture and are used mainly for this purpose. A small acreage is used for wheat and sorghum.

Erosion by wind and water is a problem.

3. Richfield-Ulysses (Silty Hardlands)

This soil association, locally called silty hardlands or hardlands, covers about 30 percent of the county. It occurs mostly in the northern half of the county and occupies nearly level (fig. 4) and gently sloping areas. The soils have a silty surface layer. The four areas of this association are shown in figure 2.

The principal soils are the Richfield and Ulysses. Richfield silt loam, the most extensive soil, occurs on the nearly level areas. Ulysses silt loams occupy the nearly level and gently sloping areas. The Ulysses soils have less clay in their subsoil than the Richfield soils.

The soils of this association are well suited to crops. Most of their acreage is used for wheat and grain sorghum. In Stevens County most of the irrigation farming is done on the soils of this association.

Wind erosion is a hazard on the nearly level areas, and wind and water erosion are hazards on the gently sloping

[1] Assisted by R. R. LEWIS, W. R. SWAFFORD, Q. L. MARKLEY, and R. E. ANTON, Soil Conservation Service.

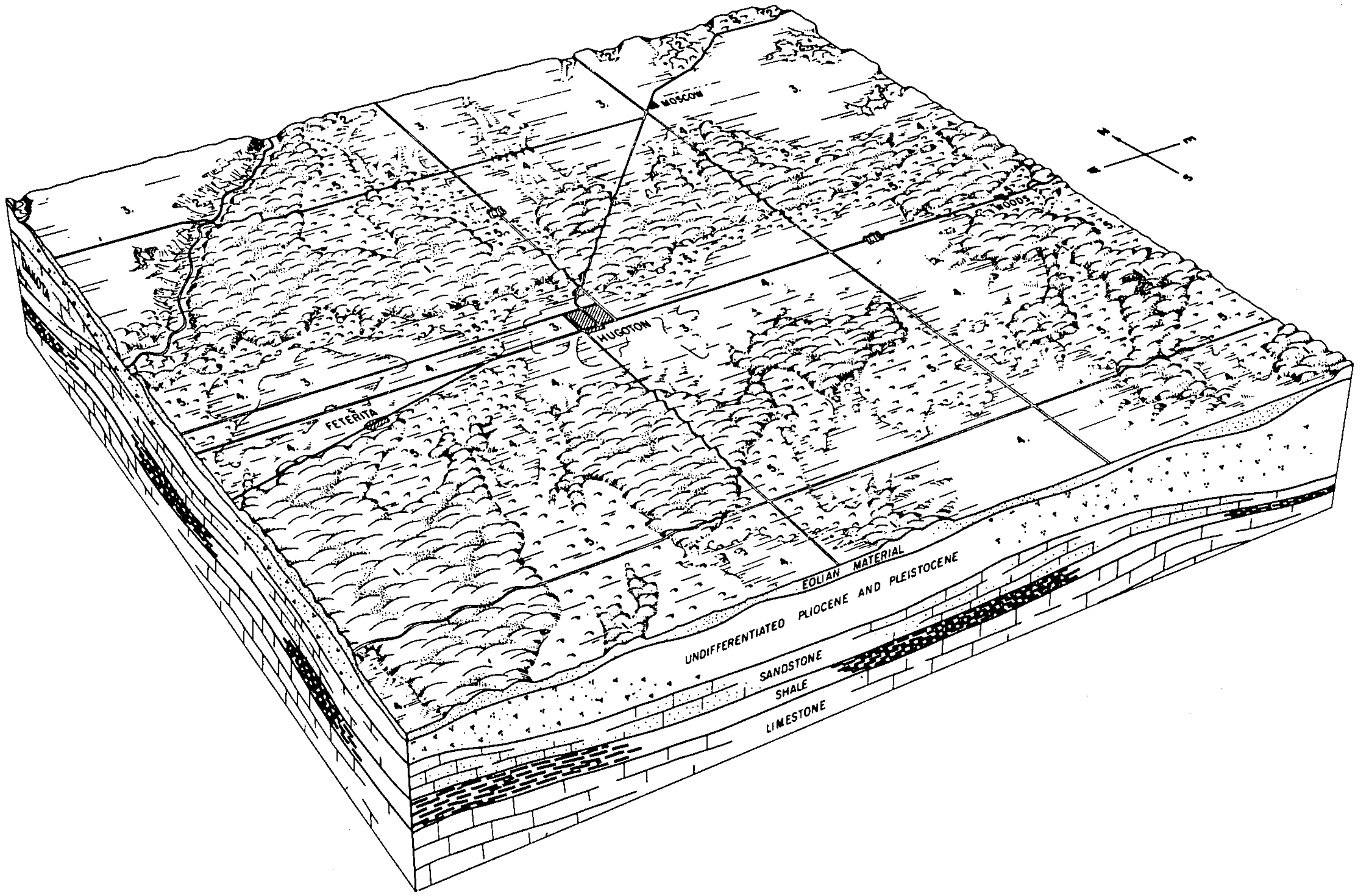


Figure 2.—**General soil areas (soil associations) in Stevens County: 1. Vona-Tivoli (sandhills); 2. Colby-Otero-Lincoln (Cimarron River Valley); 3. Richfield-Ulysses (silty hardlands); 4. Richfield-Dalhart (loamy hardlands); 5. Dalhart (sandy lands).**

areas. Water conservation is needed for profitable production of crops on all the soils in this association.

4. Richfield-Dalhart (Loamy Hardlands)

This soil association covers about 18 percent of the county. It occurs mostly in the central and southern parts. It consists of soils with loamy surface layers. The soils occupy nearly level and gently sloping areas.

Major soils are the Richfield and Dalhart. Richfield loams make up about 70 percent of this association. They occupy the nearly level areas. Dalhart fine sandy loams, which make up about 30 percent of this association, occupy the gently sloping areas. Dalhart soils contain more sand in their surface soil and subsoil than the Richfield soils.

The soils are well suited to crops. Most of this soil association is used to produce wheat and grain sorghum.

Wind erosion is a hazard on the nearly level areas, and wind and water erosion are hazards on the gently sloping areas. Water conservation is needed to produce crops profitably on all the soils in this association.

5. Dalhart (Sandy Lands)

This soil association, locally called sandy lands, covers about 19 percent of the county. It occurs in all parts of the county except the northwestern. It is composed of soils with sandy surface layers. The soils occupy nearly level and undulating areas adjacent to soils of the Vona-Tivoli association.

This association is composed of the following: Dalhart loamy fine sands, 65 percent; Richfield loamy fine sands, 25 percent; Mansic, Otero, and other soils, 10 percent. The Dalhart soils occupy the undulating areas, and the Richfield soils, the nearly level areas.

These soils are suitable for crops. Most of their acreage is used for crops, mainly sorghum. A small percentage is used for wheat.

Wind erosion is a problem. The soils, however, have the best moisture relationship of any in the county.

Effects of Erosion

Erosion is the wearing away of the earth's surface by water and wind. Accelerated soil erosion, referred to in this section as erosion, is the increased rate of erosion that is caused by human activity, whereas normal, or geologic, erosion is the continuous wearing away and rebuilding of the earth's surface.

Wind is the erosive force that does the most damage in this county. Wind erosion is always a hazard and may

***Figure 3.*—Soils of the Vona-Tivoli association.**

be serious if the soil lacks vegetation and a roughened surface. The hazard of wind erosion is related to the physical characteristics and condition of the soil. Only dry soils are moved by the wind. Soil blowing starts on the windward edge of an eroding area and increases progressively toward the leeward edge. Therefore, emergency tillage should begin on the windward edge.

All of the cultivated soils in Stevens County have had some wind erosion. In comparing cultivated soils with undisturbed soils of the same type, the cultivated soils appear to be altered only slightly. The alteration is most apparent on a few of the sandy soils that have been cultivated. These sandy soils, however, have been affected more by new deposits and by winnowing than by removal of the surface soil.

Soil blowing causes small drifts on the nearly level and gently sloping silty hardland soils (fig. 5). These drifts will become larger and more extensive (fig. 6) unless the soil is tilled to provide a roughened surface that resists erosion. The silty hardland soils show no permanent effects of wind erosion. Nevertheless, much organic matter and some clay have been removed from their surface by the wind. Only a few areas of hardland soils, too small to be mapped separately, have been eroded. The loamy hardland soils apparently contain more sand in their surface layers than they did originally. This has

***Figure 5.*—The beginning stage of soil blowing on a clean-tilled field of Richfield and Ulysses soils.**

resulted both from deposition and from winnowing. Soils that have fine sandy loam surface layers show about the same effects of wind erosion as the soils of the loamy hardlands.

Soils that have surface layers of loamy fine sand are highly susceptible to wind erosion and in places have large drifts that are as much as 10 feet high. Apparently the most damaging effect of the wind on these soils is the forming of large drifts and the loss of organic matter, silt, and clay from the plow layer. Because of shifting sand, farmers may have to plant crops two or three times to establish a stand. As a result of deposition and winnowing by the wind in some areas, some soils that originally had fine sandy loam surface layers now have 8- to 10-inch surface layers of loamy fine sand.

Although the immediate effects of wind erosion are apparent, it is difficult to identify and record the lasting effects. From field observations, the effect of wind erosion on soil productivity appears to be slight. The best method of controlling and preventing wind erosion is to maintain a cover of crop residues to protect the soil from the wind. Tillage helps to control erosion when the soil is bare, but it is not so effective as a cover of crop residue. Figure 7 shows that emergency tillage does not always control or stop wind erosion.

***Figure 4.*—Soils of the Richfield-Ulysses association on nearly level topography.**

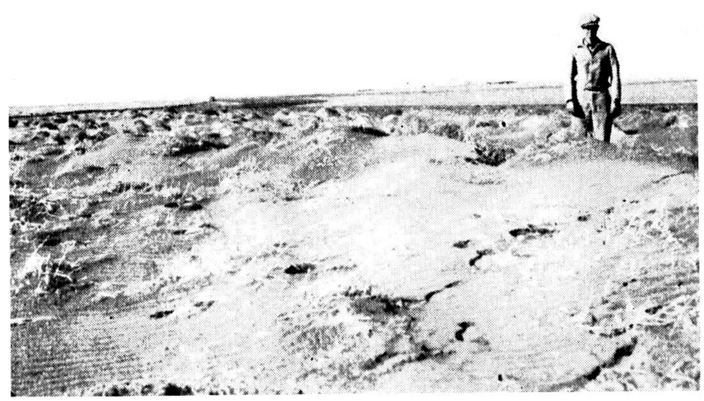


***Figure 6.*—Severe drifting occurred on the Richfield and Ulysses soils in the 1930's. Some of the drifts were 3 to 4 feet high.**

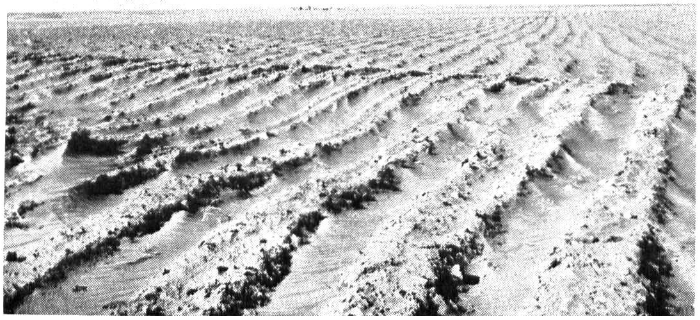


Figure 7.—**Wind erosion has occurred on this field despite emergency tillage.**

Water erosion is a hazard in Stevens County and may permanently damage the soil in sloping areas, particularly along the drainageways. Figure 8 shows the effects of sheet and rill erosion on a sloping field after intensive rainfall. On nearly level fields, water erosion normally does little permanent damage, but it is a nuisance to the farmer. A newly planted crop can be washed under by an intensive rain (fig. 9), and the crop will require replanting. Management practices that slow down or decrease runoff will conserve moisture and help control water erosion.

Besides permanent modification of the soil, erosion also causes damage to crops and native vegetation. Replanting of crops, reseeding of rangeland, and emergency tillage are needed to correct the effects of erosion, but these operations are time consuming and costly.

For specific information about the prevention and control of erosion, consult a local representative of the Soil Conservation Service.

Descriptions of the Soils

The scientist who makes a soil survey examines soils in the field, classifies the soils in accordance with facts that he observes, and maps their boundaries on an aerial photograph or other map.

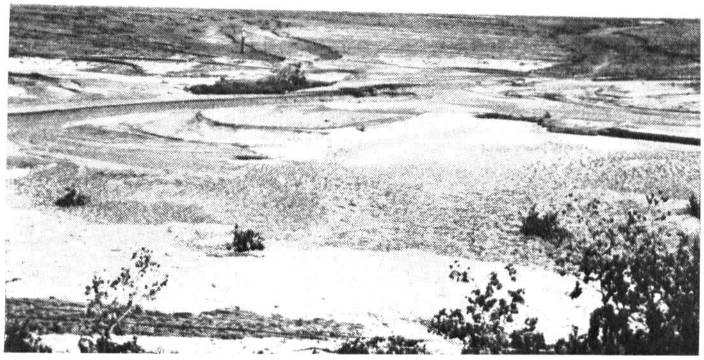


Figure 8.—**Severe water erosion on a sloping field.**

The soil scientist bores or digs many holes to see what the soils are like. The holes are not spaced in a regular pattern but are located according to the lay of the land. Usually, they are not more than a quarter of a mile apart; most of them are much closer. In most soils, such a boring, or hole, reveals several distinct layers, called horizons, which collectively are known as the soil profile. Each layer is studied to see how it differs from others in the profile and to learn the things about this soil that influence its capacity to support plant growth. Some of the characteristics observed are discussed next.

Color is usually related to the amount of organic matter. The darker the surface soil, as a rule, the more organic matter it contains. Streaks and spots of gray, yellow, and brown in the lower layers generally indicate poor drainage and poor aeration.

Texture, or the content of sand, silt, and clay, is determined by the way the soil feels when rubbed between the fingers. It is later checked by laboratory analysis. Texture determines how well the soil retains moisture and plant nutrients and whether it is easy or difficult to cultivate.

Figure 9.—**Effects of water erosion on a nearly level field.**

Structure, which is the way the individual soil particles are arranged in larger grains, and the amount of pore space between grains, gives us clues to the ease or difficulty with which the soil is penetrated by plant roots and by moisture and air.

Consistence, or the tendency of the soil to crumble or to stick together, indicates whether it is easy or difficult to keep the soil open and porous under cultivation.

Other characteristics observed in the course of the field study and considered in classifying the soil include the following: The depth of the soil over bedrock or a compact layer; the presence of gravel or stones in amounts that will interfere with cultivation; the steepness and pattern of slopes; the degree of erosion; the nature of the underlying rocks or other parent material from which the soil has developed; and the acidity or alkalinity of the soil as measured by chemical tests.

On the basis of the characteristics that are observed or are determined by laboratory tests, soils are placed in phases, types, and series. The soil type is the basic classification unit. Soils similar in kind, thickness, and arrangement of soil layers are classified as a soil type.

Because of differences other than those of kind, thickness, and arrangement of layers, some soil types are divided into two or more phases. Slope variations, frequency of rock outcrops, degree of erosion, depth of soil over the substratum, and difference in natural drainage are examples of characteristics that are used in dividing a soil type into phases.

The soil phase (or the soil type if it has not been subdivided) is the unit shown on the soil map. It is the unit that has the narrowest range of characteristics. Use and management practices, therefore, can be specified more easily for it than for a soil series or yet broader groups that contain more variation.

Two or more soil types that differ in texture of the surface soil but are otherwise similar in kind, thickness, and arrangement of soil layers are normally designated as a soil series. Each series may include several soil types and phases. In a given area, however, it frequently happens that a soil series is represented by only one soil type. Each series is named for a place near which it was first identified.

As an example of soil classification, consider the Richfield series. This series is made up of three soil types, which are subdivided into phases as follows:

Series	*Type*	*Phase*
Richfield	Richfield silt loam	Richfield silt loam, 0 to 1 percent slopes.
	Richfield loam	Richfield loam, thick surface, 0 to 1 percent slopes.
	Richfield loamy fine sand	Richfield loamy fine sand, 0 to 1 percent slopes.

Fresh, mixed stream deposits, or rough, stony, or severely eroded areas that have little true soil are not classified into types and series but are identified by descriptive names, such as Broken land or Blown-out land. These are called miscellaneous land types.

When two or more soils are so intricately associated in small areas that it is not feasible to show them separately on the soil map, they are mapped together and called a soil complex. An example in Stevens County is Dalhart-Otero fine sandy loams.

In the following pages, the soil series and the soil mappings units are described. A representative profile is given for each series. In the profile descriptions, the color of the soil material in each horizon is given in words and Munsell color notations. The color given in words, for example, "very pale brown," is the color of the soil material when dry. In the Munsell notation the color is given for the soil material when both moist and dry. In the description of each mapping unit, there is a reference to the capability unit and the range site to which the soil belongs. Technical terms used in the soil descriptions are defined in the Glossary at the back of the report.

Eroded areas that could be consistently mapped are in a separate mapping unit, for example, Ulysses-Colby complex, 1 to 3 percent slopes, eroded. Special symbols are used on the map to show eroded areas that were too small to map.

The location and distribution of the soil mapping units are shown on the detailed map in the back part of the report. The approximate acreage and the proportionate extent of the soils are given in table 1.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Blown-out land	5, 285	1. 1
Broken land	90	(1)
Colby loam, 5 to 12 percent slopes	5, 719	1. 2
Dalhart fine sandy loam, 0 to 1 percent slopes	10, 365	2. 2
Dalhart fine sandy loam, 1 to 3 percent slopes	29, 033	6. 2
Dalhart loamy fine sand, 0 to 3 percent slopes	54, 733	11. 7
Dalhart-Otero fine sandy loams	15, 825	3. 4
Goshen silt loam	113	(1)
Lincoln soils	2, 128	. 5
Lofton clay loam	1, 698	. 4
Lofton fine sandy loam	596	. 1
Mansic clay loam, 0 to 1 percent slopes	1, 125	. 3
Mansic clay loam, 1 to 3 percent slopes	1, 361	. 3
Mansic-Otero complex	1, 032	. 2
Manter fine sandy loam, 0 to 3 percent slopes	3, 507	. 8
Otero fine sandy loam, 5 to 12 percent slopes	6, 188	1. 3
Richfield loam, thick surface, 0 to 1 percent slopes	48, 219	10. 3
Richfield loamy fine sand, 0 to 1 percent slopes	12, 703	2. 7
Richfield silt loam, 0 to 1 percent slopes	40, 987	8. 8
Richfield-Ulysses loams, 0 to 1 percent slopes	23, 879	5. 1
Tivoli fine sand	5, 658	1. 2
Ulysses silt loam, 0 to 1 percent slopes	27, 641	5. 9
Ulysses silt loam, 1 to 3 percent slopes	13, 801	3. 0
Ulysses silt loam, 3 to 5 percent slopes	204	(1)
Ulysses-Colby complex, 1 to 3 percent slopes, eroded	4, 822	1. 0
Vona loamy fine sand	83, 973	18. 0
Vona-Tivoli loamy fine sands	64, 763	13. 9
Cimmarron River channel	1, 112	. 3
Total	466, 560	99. 9

[1] Less than 0.1 percent.

Colby Series

The Colby series consists of deep, light-colored, loamy soils of the moderately steep upland. The soils occur along the drains and the areas that slope to the Cimarron River. Their parent material consists of loamy and clayey sediments that were deposited by water and wind.

Colby soils are associated with the Ulysses and Otero soils in this county. They have thinner, lighter colored surface soil than the Ulysses soils, and they contain less sand than the Otero soils.

Profile of Colby loam (250 feet south of the northeast corner of NW¼ sec. 12, T. 32 S., R. 35 W.; in a native grass pasture):

A_1 0 to 4 inches, brown (10YR 5/3, dry; 3/2.5, moist) loam; weak to moderate, medium, granular structure; consistence is very friable when moist, soft when dry; many worm casts; calcareous; boundary to horizon below is gradual.

AC 4 to 11 inches, brown (10YR 5/3, dry; 4/3, moist) loam; moderate, medium, granular structure; consistence is friable when moist, hard when dry; many worm casts; calcareous; about 1 percent of layer made up of soft concretions of calcium carbonate; boundary to horizon below is gradual.

C_{ca} 11 to 24 inches, brown (10YR 5/3, dry; 4/3, moist) loam or sandy clay loam; moderate, medium, granular structure; consistence is friable when moist, hard when dry; many worm casts; calcareous; about 2 percent of layer made up of soft concretions of calcium carbonate; boundary to horizon below is gradual.

C 24 to 40 inches, very pale brown (10YR 6.5/4, dry; 5.5/4, moist) sandy clay loam or clay loam; mostly massive and porous; consistence is very hard when dry, firm when moist; calcareous; a few soft concretions of calcium carbonate.

Variations in the Colby soils are common. The A horizon is generally of loam texture and is normally less than 6 inches in thickness. The C horizon ranges from sandy loam to clay loam in texture. The soils are generally calcareous at the surface.

Colby loam, 5 to 12 percent slopes (Cm).—This soil has medium internal drainage and rapid external drainage, or runoff.

Most of it is in pasture, which is its best use. The soil is subject to water and wind erosion; water erosion is the greatest hazard. (Capability unit VIe-1 (dryland); Loamy Upland range site.)

Dalhart Series

The Dalhart series consists of deep, dark-colored, well-drained sandy soils of the upland. The soils occur on nearly level and gently sloping topography. They have a sandy surface soil and sandy clay loam subsoil. The parent material is sandy and was deposited by wind. These soils developed under a cover of tall and mid grasses.

Dalhart soils are associated with the Vona and Richfield soils in this county. They occur on smoother slopes and contain more clay in the subsoil than the Vona soils. They contain more sand and less clay and silt than the Richfield soils.

Typical profile of Dalhart fine sandy loam (300 feet south and 300 feet west of the northeast corner of the NW¼ sec. 23, T. 33 S., R. 35 W.; in a cultivated field):

A_{1p} 0 to 4 inches, grayish-brown (10YR 5/2, dry; 3/2, moist) fine sandy loam or loamy fine sand; some weak, granular structure (plow layer); consistence is soft when dry, very friable when moist; noncalcareous; boundary to horizon below is clear.

A_1 4 to 8 inches, dark grayish-brown (10YR 4/2, dry; 3/3, moist) fine sandy loam; moderate, medium, granular structure; consistence is hard when dry, friable when moist; noncalcareous; boundary to horizon below is gradual.

B_{21} 8 to 20 inches, dark grayish-brown (10YR 4/2, dry; 3/2, moist) sandy clay loam; moderate, medium, granular structure; consistence is very hard when dry, friable when moist; a few worm casts; noncalcareous; boundary to horizon below is gradual.

B_{22} 20 to 30 inches, brown (10YR 5/3, dry; 3/3, moist) sandy clay loam; mainly moderate, medium, granular structure but some weak, subangular blocky; consistence is very hard when dry, friable when moist; a few worm casts; noncalcareous; boundary to horizon below is gradual.

B_3 30 to 42 inches, brown (10YR 5/3, dry; 4/3, moist) sandy clay loam (some sand particles are larger than in horizon above); moderate, medium, granular structure; consistence is hard when dry, friable when moist; a few worm casts; noncalcareous; boundary to horizon below is gradual.

C 42 to 48 inches, brown (10YR 5/3, dry; 4/3, moist) fine sandy loam; porous; massive; consistence is soft when dry, very friable when moist; calcareous; about 2 percent of layer made up of soft concretions of calcium carbonate.

The Dalhart soils are relatively uniform. The profile, as a rule, resembles the one described. Depth to calcareous material ranges from 8 to 48 inches. In many places the texture is clay loam below a depth of 24 inches. These soils grade toward the Richfield soils in some areas.

Dalhart fine sandy loam, 0 to 1 percent slopes (Da).—This soil occurs on nearly level areas. In places it has a surface layer of loamy fine sand, up to 6 inches thick. The soil is desirable for farming.

Most of this soil is used to produce cultivated crops, mainly wheat and grain sorghum. Yields of wheat are generally higher on areas that have been fallowed to preserve moisture than on those that are continuously cropped. Wind erosion is the major hazard. (Capability unit IIIe-3 (dryland); capability unit I-2 (irrigated); Sandy range site.)

Dalhart fine sandy loam, 1 to 3 percent slopes (Db).—This soil has a profile similar to the one described. Its A and B horizons, however, are not as thick. Depth to calcareous material ranges from 8 to 20 inches. The texture of the substratum, or C horizon, ranges from sandy loam to clay loam.

Most of this soil is used to produce cultivated crops, mainly wheat and grain sorghum. Both wind and water erosion are hazards. (Capability unit IIIe-2 (dryland); capability unit IIe-2 (irrigated); Sandy range site.)

Dalhart loamy fine sand, 0 to 3 percent slopes (Df).—This soil has a profile similar to the one described, but its A_1 horizon is loamy fine sand. The thickness of the A_1 horizon is at least 6 inches and averages about 10 inches. Depth to the B_2 horizon is generally less than 20 inches. The texture of the substratum, or C horizon, ranges from sandy loam to clay loam.

Most of this soil is used to produce cultivated crops, mainly grain sorghum. Wind erosion is the principal hazard; it has caused the thick surface layer of loamy fine sand on many areas of this soil. (Capability unit IVe-3 (dryland); capability unit IIIe-4 (irrigated); Sands range site.)

Dalhart-Otero fine sandy loams (Dx).—This mapping unit is a complex, or a mixture, consisting primarily of the Dalhart and the Otero soils. The Dalhart soils make up about 65 percent of this complex, and Otero soil, about 35 percent. The soils occur on undulating areas made up of hills and small ridges and on the flat areas between the hills. Otero fine sandy loam is on most of the hills and ridges. Dalhart fine sandy loam is on the flat areas and on some of the larger hills. The soils have slopes of about 1 to 4 percent.

The Otero soil has a profile like that described for the Otero series. It is fairly uniform, light-colored fine sandy loam in both the surface soil and subsoil. It is generally calcareous at the surface. In places, however, this soil has a layer of loamy fine sand at the surface. This layer is normally less than 6 inches thick.

The profile of the Dalhart soils is similar to that described for Dalhart fine sandy loam. The Dalhart soils of this complex, however, are more variable than normal for soils of the Dalhart series. In some places they are calcareous at the surface. Commonly, they have a layer of loamy fine sand at the surface. This layer ranges from 4 to 10 inches in thickness.

Most of this complex is used to produce cultivated crops. Grain sorghum is the main crop. Both wind and water erosion are hazards. (Capability unit IVe-3 (dryland); capability unit IIIe-4 (irrigated); Sandy range site.)

Goshen Series

The Goshen series consists of deep, dark-colored silty soils that occupy the nearly level high flood plains along the North Fork of the Cimarron River. These soils are well drained. The parent material is silty and clayey sediments deposited by water. There is only a small acreage of Goshen soils in the county.

Profile of Goshen silt loam (1,300 feet east of the northwest corner of sec. 10, T. 31 S., R. 39 W.; in a native grass pasture):

A_{11} 0 to 4 inches, brown (10YR 4.5/3, dry; 3/3, moist) silt loam; moderate, medium, granular structure; consistence is slightly hard when dry, friable when moist; porous and contains many roots; noncalcareous; boundary to horizon below is gradual.

A_{12} 4 to 11 inches, brown (10YR 4.5/3, dry; 3/3, moist) loam; moderate, medium, granular structure; consistence is hard when dry, friable when moist; many worm casts; noncalcareous; boundary to horizon below is gradual.

C_1 11 to 20 inches, brown (10YR 5.5/3, dry; 4/3, moist) loam; moderate, medium, granular structure; consistence is hard when dry, friable when moist; many worm casts; calcareous; boundary to horizon below is gradual.

C_2 20 to 36 inches, pale-brown (10YR 6/3, dry; 5/3, moist) loam; weak, medium, granular structure to massive and porous; consistence is slightly hard when dry, friable when moist; a few worm casts; calcareous; some streaks and films of calcium carbonate.

In this county, the Goshen soils are relatively uniform. The texture of the A horizon is silt loam or loam.

Goshen silt loam (Go).—This soil occurs on small, nearly level flood plains bordering the North Fork of the Cimarron River. It has slopes of 0 to 1 percent. It is used wholly for pasture, but it is suitable for cultivation. (Capability unit IIIc-2 (dryland); capability unit I-1 (irrigated); Loamy Upland range site.)

Lincoln Series

The Lincoln series consists of sandy and gravelly soils that occupy the flood plains along the Cimarron River. Relief is undulating. The parent materials are sandy and gravelly sediments that were deposited by water. These soils are young and are subject to removal and redeposition by wind and water.

Profile of Lincoln loam (1,100 feet east of the southwest corner of sec. 12, T. 32 S., R. 39 W.; in a native grass pasture):

A_1 0 to 4 inches, grayish-brown (10YR 5/2, dry; 4/2, moist) loam; consistence is hard when dry, friable when moist; calcareous; boundary to horizon below is abrupt. (This horizon is made up of recently deposited layers of silty, clayey, and sandy materials.)

C_1 4 to 16 inches, very pale brown (10YR 7/3, dry; 5/3, moist) medium sand that contains about 3 to 5 percent gravel; single grain; consistence is loose when dry and when moist; calcareous; boundary to horizon below is gradual.

C_2 16 to 48 inches, very pale brown (10YR 7/3, dry; 5/3, moist) fine sand; single grain; consistence is loose when dry and when moist; calcareous. (Ground water level is at a depth of about 36 inches.)

C_3 48 to 60 inches +, stratified sand, of different sizes, and gravel.

The Lincoln soils vary in characteristics. They are made up mostly of stratified sand and gravel.

Lincoln soils (Lf).—These soils occur from 1 to 8 feet above the river channel. Slopes range from 0 to 3 percent. Depth to the water table varies but is usually less than 10 feet. A few small areas that have silty or clayey upper layers are included with this mapping unit. These finer textured layers are generally less than 24 inches thick.

Most areas of Lincoln soils are used for pasture. These soils are unsuitable for crops. They are so unstable that a stand of native grass is difficult to maintain. (Capability unit VIIw-1, dryland.)

Lofton Series

The Lofton series consists of deep, dark-colored poorly drained soils. These soils occupy shallow, round, or oblong depressions in the upland. The depressions are generally less than 40 acres in size. Water from surrounding soils may cover the depressions for several days before it soaks into the soil or evaporates. The Lofton soils have sandy to clayey surface soil and clayey subsoil. The parent material consists of sandy, silty, and clayey sediments. Because they receive extra water, the soils are more developed, or more mature, than any other soil in the county.

Lofton soils have darker colored and more clayey surface soil and subsoil than the associated Richfield and Dalhart soils.

Profile of Lofton clay loam (50 feet west and 1,000 feet north of the southeast corner of NE¼ sec. 20, T. 31 S., R. 35 W.; in a cultivated field):

A_{1p} 0 to 3 inches, dark-brown (10YR 4/3, dry; 3/2, moist) clay loam; some weak, granular structure (plow layer); consistence is very friable when moist, slightly hard when dry; boundary to horizon below is clear.

A_1 3 to 7 inches, very dark grayish-brown (10YR 3/2, dry; 2/2, moist) clay loam; moderate, medium, granular structure; consistence is slightly hard when dry, friable when moist; boundary to horizon below is clear.

B_{21} 7 to 12 inches, dark grayish-brown (10YR 4/2, dry; 3/2, moist) silty clay; compound structure—weak, medium, prismatic and moderate, medium to fine, subangular blocky; visible, continuous clay films on the structural aggregates; consistence is very hard when dry, firm to very firm when moist; boundary to horizon below is gradual.

B_{22} 12 to 18 inches, dark grayish-brown (10YR 4/2, dry; 3/2, moist) silty clay; weak, medium to fine, subangular blocky structure to massive (structureless) (soil was moist to wet when structure was observed); a few discontinuous clay films on the structural aggregates; consistence is very hard when dry, firm to very firm when moist; a few worm casts; boundary to horizon below is gradual.

B_3 18 to 23 inches, dark-brown (10YR 4/3, dry; 3/3, moist) clay loam; some weak, medium, granular structure but mostly massive (structureless); consistence is hard when dry, firm when moist; a few worm casts; boundary to horizon below is clear.

B_{3ca} 23 to 35 inches, brown (10YR 5/3, dry; 4/3, moist) clay loam; some granular structure but mostly massive and porous; consistence is hard when dry, firm when moist; a few worm casts; calcareous; boundary to horizon below is gradual.

C 35 to 45 inches, brown (10YR 5/3, dry; 3/4, moist) clay loam; massive and porous; consistence is hard when dry, firm when moist; a few worm casts; calcareous; about 2 percent of layer made up of soft concretions of calcium carbonate.

The Lofton soils have a profile somewhat similar to the profile described, although the profile varies from one depression to another. The B_2 horizon may have a few streaks and mottles—an indication of poor drainage. Depth to the horizon of lime accumulation is generally more than 24 inches. The soil in a few depressions in the county has clay-textured A and B horizons.

Lofton clay loam (Lo).—Most of this soil is used to produce cultivated crops, principally wheat and grain sorghum. Slopes range from 0 to 1 percent. Ponded water on the surface of the soil is the main problem. About half of the time, water drowns the crops or delays planting and harvesting until the crops are lost. Wind erosion is a hazard if the soil has no plant cover during a drought. (Capability unit IVw–1 (dryland); Loamy Upland range site.)

Lofton fine sandy loam (Lp).—The profile of this soil is similar to the profile described, but the A horizon consists of fine sandy loam. Slopes range from 0 to 1 percent. The soil is generally surrounded by Dalhart soils. Grain sorghum is the principal crop. The hazards on this soil are the same as on Lofton clay loam. (Capability unit IVw–1 (dryland); Sandy range site.)

Mansic Series

The Mansic series consists of deep, moderately dark colored soils of the upland. The soils have clayey surface soil and subsoil. They occur in nearly level and gently sloping areas and make up only a small total acreage in the county. These soils are well drained. They have a moderate rate of water intake and a high water-holding capacity. Their parent material consists of clayey and sandy sediments. The soils have developed under a cover of short and mid grasses.

Mansic soils are associated with Ulysses, Richfield, and Dalhart soils. They contain more clay in their surface soil and subsoil than the Ulysses and Dalhart soils. They have a more clayey surface soil and a lighter colored subsoil than the Richfield soils.

Profile of Mansic clay loam (500 feet east and 200 feet north of the southwest corner of the NW¼ sec. 11, T. 33 S., R. 38 W.; in a cultivated field):

A_{1p} 0 to 5 inches, brown (10YR 5/3, dry; 4/3, moist), light clay loam; some weak, granular structure (plow layer); consistence is slightly hard when dry, friable when moist; boundary to horizon below is clear.

AC 5 to 15 inches, yellowish-brown (10YR 5/4, dry; 4/3, moist) clay loam; moderate, medium to fine, granular structure; consistence is hard when dry, firm when moist; a few worm casts; calcareous; boundary to horizon below is gradual.

C_{ca1} 15 to 20 inches, light yellowish-brown (10YR 6/4, dry; 5/3, moist) clay loam; moderate, medium, granular structure; consistence is hard when dry, friable when moist; many worm casts; calcareous; about 1 percent of layer made up of soft concretions of calcium carbonate; boundary to horizon below is gradual.

C_{ca2} 20 to 28 inches, light yellowish-brown (10YR 6/4, dry; 5/4, moist) clay loam (contains less sand than horizon above); moderate, medium, granular structure; consistence is very hard when dry, firm when moist; many worm casts; calcareous; about 1 percent of layer made up of soft concretions of calcium carbonate; boundary to horizon below is gradual.

C 28 to 39 inches, reddish-brown (5YR 5/4, dry; 4/4, moist) clay loam; massive and porous; consistence is very hard when dry, firm when moist; a few worm casts; calcareous; about 2 percent of layer made up of soft concretions of calcium carbonate.

The Mansic soils vary in color, but their texture is similar to that described in the profile. They are generally calcareous at the surface.

Mansic clay loam, 0 to 1 percent slopes (Ma).—This soil occurs on nearly level areas that are apparently old deflation basins. Runoff from surrounding areas provides some extra moisture in places. Most of this soil is used to produce cultivated crops, mainly wheat and grain sorghum. Wind erosion is the chief hazard, but, occasionally, ponded water will affect the growth of crops. (Capability unit IIIc–1 (dryland); capability unit I–1 (irrigated); Loamy Upland range site.)

Mansic clay loam, 1 to 3 percent slopes (Mb).—This soil generally is calcareous at the surface. Its profile is similar to the one described and is more uniform than the profile of Mansic clay loam, 0 to 1 percent slopes. There is only a small acreage of this soil in the county. All of it is used to produce cultivated crops, mainly wheat and grain sorghum. Both wind and water erosion are hazards. (Capability unit IIIe–1 (dryland); capability unit IIe–1 (irrigated); Loamy Upland range site.)

Mansic-Otero complex (Mx).—This complex of soils consists primarily of Mansic clay loam and Otero fine sandy loam. Its total acreage in Stevens County is small. Mansic clay loam makes up about 70 percent of this complex and Otero fine sandy loam, about 30 percent. The landscape is a series of hills and small ridges with flat areas between the hills. The soils are usually calcareous at the surface. Slopes range from 1 to 6 percent.

Mansic clay loam is relatively uniform and has a profile similar to the profile described for the Mansic series. It occurs on the flat areas and some of the small hills.

Otero fine sandy loam is relatively uniform, but throughout its profile it contains more clay than the profile described for the Otero series. It occurs on the larger hills and on steep slopes.

About half of this complex of soils is used to produce cultivated crops, mainly wheat and grain sorghum. The rest is used for pasture. Both wind and water erosion are hazards. (Capability unit VIe–1 (dryland); Loamy Upland range site.)

Manter Series

The deep, moderately dark colored soils of the Manter series occur on nearly level to gently sloping upland. The surface soil and subsoil are fine sandy loam. The parent material consists of sandy sediments that were transported by wind. These soils have developed under a cover of mid and tall grasses.

The Manter soils are associated with the Dalhart, Richfield, and Ulysses soils. They have more sand and less clay in the subsoil than the Dalhart soils and more sand and less clay and silt in the surface soil and subsoil than the Richfield and Ulysses soils.

Profile of Manter fine sandy loam (50 feet north and 1,100 feet west of the southeast corner of sec. 18, T. 33 S., R. 36 W.; in a cultivated field):

A_{1p} 0 to 7 inches, dark-brown (10YR 4/3, dry; 3/3, moist) fine sandy loam (plow layer); some granular structure in the lower part of this horizon; consistence is hard when dry, very friable when moist; boundary to horizon below is gradual.

A_{11} 7 to 17 inches, yellowish-brown (10YR 5/4, dry; 4/4, moist) fine sandy loam; weak, medium, granular structure; consistence is slightly hard when dry, friable when moist; boundary to horizon below is gradual.

A_{12} 17 to 21 inches, dark-brown (10YR 4/3, dry; 3/3, moist) fine sandy loam; weak, medium, granular structure; consistence is soft when dry, very friable when moist; a few worm casts; boundary to horizon below is clear.

C_{ca} 21 to 36 inches, brown (10YR 5/3, dry; 4/3, moist), light fine sandy loam; very weak, granular structure to single grain; consistence is soft when dry, very friable when moist; a few worm casts; calcareous; a few streaks and films of calcium carbonate; boundary to horizon below is gradual.

C 36 to 45 inches, light yellowish-brown (10YR 6/4, dry; 5/4, moist) loamy fine sand; single grain; consistence is soft when dry, very friable when moist; calcareous; streaks and films of calcium carbonate.

In places the upper part of the A horizon is loamy fine sand that is less than 6 inches thick. The lower part of the A horizon may be darker colored than that described in the profile. The substratum, the material below a depth of 30 inches, may range in texture from loamy fine sand to clay loam. Depth to calcareous material is generally less than 30 inches. In some places small areas of these soils are severely eroded and calcareous at the surface.

Manter fine sandy loam, 0 to 3 percent slopes (My).—This soil occurs mainly on small ridges in the Richfield-Ulysses and Richfield-Dalhart soil associations. Its water-holding capacity is adequate for the production of crops. Most of the soil is used to produce cultivated crops, mainly wheat and grain sorghum. Both wind and water erosion are hazards. (Capability unit IIIe-2 (dryland); capability unit IIe-2 (irrigated); Sandy range site.)

Miscellaneous Land Types

The areas mapped as miscellaneous land types have little or no natural soil. They are not well suited to agricultural use. The miscellaneous land types in this county are Blown-out land and Broken land. A description of each follows.

Blown-out land (Bo).—The areas of blowouts and severely eroded land that are almost without vegetation make up this land type. They are composed of sand or loamy sand that is still being shifted by the wind. Slopes range from 5 to 15 percent. The areas occur in association with the Vona and Tivoli soils. Vegetation is difficult to establish.

Consult a local representative of the Soil Conservation Service for information about revegetation of Blown-out land. Suggestions on the management of areas that have been revegetated are given in the discussion of capability unit VIIe-1 (dryland). (Choppy Sands range site.)

Broken land (Bx).—These areas occupy the channel and banks of the North Fork of the Cimarron River. Broken land supports a sparse stand of short and mid grasses and annual weeds. Pasture is about the only use for these areas. Suggestions for the management of these areas are given in the discussion of capability unit VIIw-1 (dryland).

Otero Series

The Otero series consists of deep, light-colored sandy soils of the upland. These soils occupy the moderately steep slopes along the Cimarron River. There are a few deposits of gravel in the soils. The parent material consists of sandy and loamy sediments that were deposited by water and wind.

Otero soils are associated with the Colby and Dalhart soils in this county. They contain more sand than the Colby soils and have a less clayey subsoil than the Dalhart soils.

Profile of Otero fine sandy loam (100 feet east and 100 feet south of the northwest corner of sec. 3, T. 31 S., R. 35 W.; in a pasture):

A_1 0 to 7 inches, brown (10YR 5/3, dry; 3/2, moist) fine sandy loam; weak, medium, granular structure with some platy structure at the surface; consistence is slightly hard when dry, very friable when moist; weakly calcareous; boundary to horizon below is gradual.

AC 7 to 24 inches, brown (10YR 5/3, dry; 4/3, moist) fine sandy loam; weak to moderate, medium, granular structure; consistence is hard when dry, very friable when moist; a few worm casts; calcareous; boundary to horizon below is gradual.

C 24 to 36 inches, light yellowish-brown (10YR 6/4, dry; 5/3, moist) loamy fine sand or fine sandy loam; weak, fine, granular structure to single grain; consistence is soft when dry, very friable when moist; calcareous; a few soft concretions of calcium carbonate.

Variations in the Otero soils are common. The texture of the A horizon is normally fine sandy loam. The A horizon is generally less than 8 inches thick. The texture of the C horizon is variable; it ranges from loamy sand to sandy clay loam. In some places the C horizon contains a high percentage of gravel. In many places these soils are calcareous at the surface.

Otero fine sandy loam, 5 to 12 percent slopes (Ot).—This soil occurs on moderately steep slopes. It has good internal drainage and rapid external drainage, or runoff. The soil is used mostly for pasture, which is its best use. It is susceptible to both water and wind erosion, but water erosion is the greater hazard. (Capability unit VIe-3 (dryland); Sandy range site.)

Richfield Series

The Richfield series consists of deep, dark-colored soils of the nearly level upland. These soils have a clayey subsoil; the surface soil, however, varies in texture. The Richfield soils are the most extensive soils in the county. They are well drained. Their parent material consists of loess or similar silty sediments. These soils have developed under a cover of short and mid grasses.

Richfield soils are associated with the Ulysses and Dalhart soils in this county. They have a more clayey subsoil and are noncalcareous to a greater depth than the Ulysses soils, and they contain more clay and less sand in their subsoil than the Dalhart soils. They have a higher degree of horizon development than the Dalhart and Ulysses soils.

Richfield silt loam, 0 to 1 percent slopes (Rm).—This soil occurs on nearly level areas, mostly in the northern part of the county. Soil permeability is moderately slow.

Typical profile (located 400 feet south and 500 feet west of the northeast corner of sec. 29, T. 31 S., R. 35 W.; in a cultivated field):

A_1 0 to 9 inches, dark grayish-brown (10YR 4/2, dry; 3/2, moist) silt loam; moderate, fine and medium, granular structure (0 to 5 inches of the plow layer is almost structureless); consistence is friable when moist, slightly hard when dry; porous; a few worm casts; noncalcareous; boundary to horizon below is clear.

B_{21} 9 to 22 inches, brown (10YR 4.5/3, dry; 3.5/3, moist) silty clay loam; compound structure—moderate, medium, prismatic and moderate, medium, subangular blocky; the structural aggregates are covered with thin, continuous clay films; consistence is firm when moist, hard when dry; noncalcareous; boundary to horizon below is gradual.

B_{2ca} 22 to 37 inches, brown (10YR 5.5/3, dry; 4.5/3, moist) silty clay loam; moderate, medium, subangular blocky structure; some of the structural aggregates are coated with spotty, thin clay films; consistence is firm when moist, hard when dry; calcareous; a few streaks and films of calcium carbonate; boundary to horizon below is clear.

C_{ca} 37 to 41 inches, pale-brown (10YR 6.5/3, dry; 5/3, moist) silt loam; weak, fine, granular structure to massive and porous; consistence is friable when moist, hard when dry; calcareous; a few soft concretions of calcium carbonate.

The profile of this soil is relatively uniform. The A horizon is generally less than 10 inches thick. Depth to the horizon of calcareous material ranges from 14 to 24 inches. In some areas the soil grades toward the Ulysses soils.

This is a suitable soil for farming. Most of it is used for cultivated crops, principally wheat. Storage of moisture through fallowing of the soil is essential for profitable crop yields. Wind erosion is the major hazard. (Capability unit IIIc-1 (dryland); capability unit I-1 (irrigated); Loamy Upland range site.)

Richfield loam, thick surface, 0 to 1 percent slopes (Ra).—This soil occurs on nearly level areas. It has moderately slow permeability.

Typical profile (300 feet south and 200 feet west of the northeast corner of sec. 17, T. 35 S., R. 36 W.; in a cultivated field):

A_{1p} 0 to 4 inches, grayish-brown (10YR 5/2, dry; 3/2, moist) fine sandy loam or loam; weak, fine, granular structure (plow layer); consistence is very friable when moist, slightly hard when dry; noncalcareous; boundary to horizon below is clear.

A_1 4 to 8 inches, brown (10YR 5/3, dry; 3/3, moist) loam; moderate, medium, granular structure; consistence is friable when moist, hard when dry; porous; a few worm casts; noncalcareous; boundary to horizon below is gradual.

A_3 8 to 15 inches, brown (10YR 5/3, dry; 3/3, moist) loam or clay loam; moderate, medium, granular structure; consistence is friable when moist, very hard when dry; porous; many worm casts; noncalcareous; boundary to horizon below is gradual.

B_2 15 to 29 inches, brown (10YR 5/3, dry; 4/3, moist) clay loam; compound structure—moderate, medium, prismatic and moderate, medium, subangular blocky; structural aggregates are coated with thin, continuous clay films; consistence is firm when moist, very hard when dry; a few worm casts; boundary to horizon below is gradual.

B_{2ca} 29 to 40 inches, light brownish-gray (10YR 6/2, dry; 4/2, moist) clay loam; mostly massive and porous; consistence is friable when moist, hard when dry; a few worm casts; calcareous; about 1 percent of layer made up of soft concretions of calcium carbonate.

The profile is relatively uniform. The A horizon is generally more than 10 inches thick. Depth to the horizon of calcareous material ranges from 18 to 40 inches. In places this soil has a thin surface layer (less than 4 inches thick) of loamy fine sand. Richfield loam, thick surface, 0 to 1 percent slopes, grades toward the Dalhart soils in some areas. In places it is transitional between Richfield silt loam, 0 to 1 percent slopes, and the sandy Dalhart and Vona soils.

This is the best soil for farming in the county. Most of it is used to produce cultivated crops, mainly wheat and grain sorghum. Storage of moisture through fallowing of the soil is essential in most years for profitable yields of wheat. Wind erosion is the major hazard. (Capability unit IIIc-1 (dryland); capability unit I-1 (irrigated); Loamy Upland range site.)

Richfield loamy fine sand, 0 to 1 percent slopes (Rb).—This soil occupies large, nearly level areas of sandy land. Permeability of the soil is moderately slow. The soil has a moderate to rapid rate of water intake.

Typical profile (500 feet south and 200 feet east of the northwest corner of the NE¼ sec. 5, T. 35 S., R. 38 W.; in a cultivated field):

A_1 0 to 10 inches, light brownish-gray (10YR 6/2, dry; 5/2, moist) loamy fine sand; single grain; consistence is loose when dry and when moist; noncalcareous; boundary to horizon below is gradual.

A_3 10 to 14 inches, dark-brown (7.5YR 4/2, dry; 3/2, moist) fine sandy loam; moderate, medium, granular structure; consistence is hard when dry, very friable when moist; a few worm casts; noncalcareous; boundary to horizon below is gradual.

B_1 14 to 19 inches, brown (10YR 5/3, dry; 3/3, moist) sandy clay loam; moderate, medium, granular structure; consistence is hard when dry, friable when moist; many worm casts; noncalcareous; boundary to horizon below is gradual.

B_2 19 to 37 inches, brown (10YR 5/3, dry; 3/3, moist) clay loam; compound structure—moderate, medium, prismatic and moderate, medium, subangular blocky; some of the structural aggregates are coated with thin films of clay; consistence is very hard when dry, firm when moist; a few worm casts; noncalcareous; boundary to horizon below gradual.

B_{3ca} 37 to 42 inches, brown (10YR 5/3, dry; 4/3, moist) clay loam; moderate, medium, granular structure; consistence is hard when dry, friable when moist; calcareous; a few small, soft concretions of calcium carbonate; boundary to horizon below is gradual.

C_{ca} 42 to 48 inches, light-gray (10YR 7/2, dry; 5/2, moist) clay loam; massive and porous; calcareous; about 1 percent of layer made up of small, soft concretions of calcium carbonate.

Variations in this soil are common. The A horizon ranges from 6 to 16 inches in thickness. The A_3 horizon is generally present, but the B_1 horizon does not occur consistently. Depth to the B_2 horizon is generally less than 20 inches. Depth to the horizon of calcareous material ranges from 20 to 48 inches. This soil grades toward the Dalhart soils in some areas.

This is a suitable soil for farming. Most of it is used to produce cultivated crops, mainly grain sorghum. A small acreage is used to grow wheat. Profitable crop yields can be produced more consistently on this soil than on any other soil in the county. It is usually difficult to get a good stand of crops because of soil blowing. (Capability unit IVe-3 (dryland); capability unit IIIe-4 (irrigated); Sands range site.)

Richfield-Ulysses loams, 0 to 1 percent slopes (Rx).—This mapping unit is a complex of two soils. Richfield loam makes up 75 percent of the complex, and Ulysses loam, about 25 percent. A typical area is in sec. 9, T. 32 S., R. 35 W. The profile of Richfield loam is like the profile described for Richfield loam, thick surface, 0 to 1 percent slopes. The profile of Ulysses loam is like the profile described for the Ulysses series.

Most of this complex is used for cultivated crops. Wheat is the principal crop. Storage of moisture through fallowing is essential for profitable crop yields. Wind erosion is a major hazard. (Capability unit IIIc–1 (dryland); capability unit I–1 (irrigated); Loamy Upland range site.)

Tivoli Series

Tivoli soils are deep, light colored, and sandy. They occur on the dune-type and hilly topography on the upland adjacent to the Cimarron River. The parent material is sand that was transported by the wind. These soils are fairly well stabilized by perennial vegetation.

Tivoli soils are associated with the Vona soils in this county. They contain more sand and occur on steeper, more undulating topography than the Vona soils.

Typical profile of Tivoli fine sand (200 feet north of the southeast corner of the SW¼ sec. 21, T. 31 S., R. 38 W.; in a native grass pasture):

A_1 0 to 4 inches, brown (10YR 5/3, dry; 4/3, moist) loamy fine sand or fine sand; single grain; consistence is loose when dry and when moist; noncalcareous; horizon is made up largely of recently deposited silty and sandy material; boundary to horizon below is clear.

C_1 4 to 30 inches, light yellowish-brown (10YR 6/4, dry; 5/4, moist) fine sand; single grain; consistence is loose when dry and when moist; noncalcareous; boundary to horizon below is gradual.

C_2 30 to 41 inches, very pale brown (10YR 7/4, dry; 6/4, moist) fine sand; single grain; consistence is loose when dry and when moist; calcareous.

Tivoli soils are relatively uniform throughout the county and have profiles similar to the one described. The thickness of the darkened surface layer ranges from about 2 to 8 inches.

Tivoli fine sand (Tf).—This soil absorbs water rapidly, but its moisture-holding capacity is low. It occurs on young dunes and on hilly to steep topography. Slopes range from 10 to 25 percent.

Most of this soil is used for pasture, which is its best use. The soil is very susceptible to wind erosion. It should be managed so as to maintain a permanent cover of vegetation. Establishing plant cover is difficult if this soil is allowed to become bare of vegetation. (Capability unit VIIe–1 (dryland); Choppy Sands range site.)

Ulysses Series

The Ulysses series consists of deep, moderately dark colored soils of the upland. These soils occur on nearly level, gently sloping, and sloping areas. They have a silty surface soil and subsoil. The parent material consists of silty sediments, or loess. These soils have developed under a cover of short and mid grasses. Permeability is moderately slow.

Ulysses soils are associated with the Richfield, Colby, and Dalhart soils in this county. They are less compact and have less clay in the subsoil than the Richfield soils, are darker than the Colby soils, and contain less sand than the Dalhart soils.

Typical profile of Ulysses silt loam (400 feet east and 500 feet north of the southwest corner of the NW¼ sec. 12, T. 31 S., R. 35 W.; in a cultivated field):

A_{1p} 0 to 6 inches, dark grayish-brown (10YR 4/2, dry; 3/2, moist) silt loam; weak, fine, granular structure (plow layer); consistence is soft when dry, friable when moist; noncalcareous; boundary to horizon below is gradual.

B_2 6 to 13 inches, dark grayish-brown (10YR 4.5/2, dry; 3/3, moist) silt loam or silty clay loam; moderate, medium, granular structure; consistence is slightly hard when dry, friable when moist; a few worm casts; noncalcareous; boundary to horizon below is clear.

B_{3ca} 13 to 23 inches, pale brown (10YR 6/3, dry; 5/3, moist) silt loam; weak to moderate, medium, granular structure; consistence is slightly hard when dry, friable when moist; many worm casts; calcareous; boundary to horizon below is gradual.

C_{ca} 23 to 43 inches, very pale brown (10YR 7/3, dry; 6/4, moist) silt loam; massive and porous; consistence is slightly hard when dry, friable when moist; calcareous, with about 5 percent of the layer made up of soft concretions of calcium carbonate.

In this county the Ulysses soils are relatively uniform. The texture of the A horizon ranges from silt loam to loam. Depth to calcareous material averages about 8 inches. Where these soils are calcareous at the surface, they usually have a lighter colored surface soil than that described in the profile. The B horizon is generally indistinct. All of these soils contain worm casts. The Ulysses soils grade toward the Richfield and Colby soils in some areas. In some places there are small areas of light-colored, eroded soil.

Ulysses silt loam, 0 to 1 percent slopes (Ua).—Most of this soil is used for cultivated crops, principally wheat. Storage of moisture through fallowing is essential for profitable crop yields. Wind erosion is the major hazard. Most of the light-colored spots in this soil have been caused by erosion. (Capability unit IIIc–1 (dryland); capability I–1 (irrigated); Loamy Upland range site.)

Ulysses silt loam, 1 to 3 percent slopes (Ub).—This soil has a profile similar to the one described. Depth to the calcareous material averages about 6 inches. More light-colored spots occur in this soil than in Ulysses silt loam, 0 to 1 percent slopes.

Most of the soil is used for cultivated crops, mainly wheat and grain sorghum. Storage of moisture through fallowing is essential for profitable crop yields. Wind and water erosion are hazards. (Capability unit IIIe–1 (dryland); capability unit IIe–1 (irrigated); Loamy Upland range site.)

Ulysses silt loam, 3 to 5 percent slopes (Uc).—This soil has a profile similar to the one described. Where this soil has not been cultivated, the dark-colored surface layer generally is not so thick as that of Ulysses silt loam, 0 to 1 percent slopes. Where the soil is cultivated, this layer is thin and, in some places, absent.

About half of the small acreage of this soil is used for cultivated crops, mainly wheat; the other half is used for pasture. Storage of moisture through fallowing is essential for profitable crop yields. Wind and water ero-

sion are hazards. (Capability unit IVe-2 (dryland); Loamy Upland range site.)

Ulysses-Colby complex, 1 to 3 percent slopes, eroded (Ue).—This mapping unit is a complex, or mixture, that consists primarily of Ulysses soils and Colby soils. The Colby soils make up about 35 percent of the complex, and the Ulysses soils, about 65 percent. This complex of soils is generally on small ridges and knolls where slopes range from 1 to 3 percent. Most areas are a part of the Richfield-Ulysses soil association.

The Colby soils, the eroded members of this complex, occur mainly on the tops of ridges and knolls. The surface soil is generally calcareous and ranges from fine sandy loam to clay loam. The Colby soils of this complex have a profile similar to that described for the Colby series.

The Ulysses soil occupies the side slopes of ridges and knolls. The texture of the surface soil is generally loam. The Ulysses soil of this complex has a profile similar to that described for the Ulysses series.

Most of the acreage of this complex is used for cultivated crops, mainly wheat. Wind and water erosion are hazards. (Capability unit IVe-2 (dryland); Loamy Upland range site.)

Vona Series

The Vona series consists of deep, light-colored sandy soils of the upland. The soils occur on the rolling, subdued, dunelike topography. They rank second in the county in total acreage. Their parent material is sand that was transported by wind. These soils have developed under a cover of tall and mid grasses.

The Vona soils are associated with the Tivoli and Dalhart soils. They have a less sandy subsoil than the Tivoli soils and have more mature, dunelike topography. The subsoil of the Vona soils is less clayey than that of the Dalhart soils.

Typical profile of Vona loamy fine sand (1,500 feet north and 500 feet west of the southeast corner of the SW¼ sec. 28, T. 32 S., R. 37 W.; in a cultivated field):

A_1 0 to 19 inches, brown (10YR 5.5/3, dry; 4/3, moist) loamy fine sand; single grain; consistence is loose when dry or when moist; noncalcareous; boundary to horizon below is gradual.

B_{21} 19 to 35 inches, brown (10YR 4.5/3, dry; 4/3, moist) fine sandy loam; weak, medium, granular structure; consistence is very friable when moist, slightly hard when dry; noncalcareous; boundary to horizon below is gradual.

B_{22} 35 to 48 inches, pale-brown (10YR 6/3, dry; 5/3, moist) fine sandy loam; weak to moderate, medium, granular structure; consistence is very friable when moist, slightly hard when dry; noncalcareous.

In this county the Vona soils are relatively uniform. The A horizon is generally less than 20 inches thick. Depth to calcareous material ranges from 2 to 6 feet. In some places the soils grade toward the Tivoli and Dalhart soils.

Vona loamy fine sand (Vo).—This soil occurs on rolling or undulating topography. Slopes are generally from 1 to 5 percent. The soil absorbs water rapidly. It retains more precipitation for use by crops than most soils in the county.

About 70 percent of this soil is used for cultivated crops, principally sorghum. Because it is subject to wind erosion, this soil is not well suited to cultivation. It produces, however, fair yields of cultivated crops almost every year. Wind erosion is the major problem. The wind moves the sand particles easily. As a result, it is difficult to establish stands of crops. Even where this soil is used for pasture, wind erosion is a hazard. (Capability unit IVe-1 (dryland); capability unit IVe-4 (irrigated); Sands range site.)

Vona-Tivoli loamy fine sands (Vx).—This complex consists primarily of Vona and Tivoli soils. The Tivoli soil makes up about 40 percent of the complex and the Vona soil, about 60 percent. The areas are mainly rolling to hilly. Slopes range from 3 to 20 percent.

The Tivoli soil occurs on the larger and steeper hills. The texture of the surface soil is generally loamy fine sand. The soil has a profile similar to that described for the Tivoli series.

The Vona soil occurs on the smoother areas of this complex. The texture of the surface soil is generally loamy fine sand. The Vona soil has a profile like that described for the Vona series.

About one-third of the acreage of this complex is used for cultivated crops, mainly sorghum. The soils, however, are best used for pasture. Wind erosion is a great hazard, and perennial vegetation should be maintained to protect the soils. (Capability unit VIe-2 (dryland); Sands range site.)

Use and Management of the Soils

Use and management of the soils of Stevens County are discussed in this section. The capability classification system used by the Soil Conservation Service is explained. Dryland and irrigation farming are discussed, and management by capability units is given for soils under each type of farming. Productivity and yields of the soils are also discussed. Sections on rangeland, woodland, and wildlife management are included.

Capability Groups of Soils

The capability classification is a grouping that shows, in a general way, how suitable soils are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. The eight capability classes, the broadest grouping, are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the remaining classes have progressively greater natural limitations. In class VIII are soils and land types so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, grazing, or wood products. There are no class VIII soils in Stevens County.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be up to four subclasses. The subclass is indicated by adding a small letter—*e*, *w*, *s*, or *c*—to the class numeral; for example, IIe. The letter *e* shows that the main limita-

tion is risk of erosion; *w* means that water in or on the soil will interfere with plant growth or cultivation (in some soils wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, stony, or has low fertility that is difficult to correct; and *c*, used in only some parts of the country, indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c* because the soils in it have little or no erosion hazard but have other limitations that limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other response to management. Thus, the capability unit is a convenient grouping for many statements about management of soils. Capability units are generally identified by numbers assigned locally, for example, IIe-1 or IIIc-2.

The capability classes used in this county, and the subclasses and units in them, are described in the two lists that follow.

Capability Classification for Irrigation Farming

Class I.—Soils that have few limitations that restrict their use.
    Unit I-1: Loamy soils on nearly level upland.
    Unit I-2: Fine sandy loam soils on nearly level upland.
Class II.—Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.
  Subclass IIe: Soils that have a moderate risk of erosion.
    Unit IIe-1: Loamy soils on gently sloping upland.
    Unit IIe-2: Fine sandy loam soils on gently sloping upland.
Class III.—Soils that have severe limitations that reduce the choice of plants or require special conservation practices, or both.
  Subclass IIIe: Soils that are highly susceptible to erosion when used for crops.
    Unit IIIe-4: Mainly loamy fine sand soils on nearly level to gently sloping and undulating upland.
Class IV.—Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.
  Subclass IVe: Soils that have a severe risk of erosion if they are cultivated and not protected.
    Unit IVe-4: Loamy fine sand soils on rolling upland.

Capability Classification for Dryland Farming

Class III.—Soils that have severe limitations that reduce the choice of plants or require special conservation practices, or both.
  Subclass IIIc: Soils that have moderate climatic limitations.
    Unit IIIc-1: Deep, dark-colored silty soils of the nearly level upland.
    Unit IIIc-2: Deep, dark-colored soils on small flood plains.
  Subclass IIIe: Soils that are highly susceptible to erosion when used for crops.
    Unit IIIe-1: Deep, moderately dark colored loamy soils on gently sloping upland.
    Unit IIIe-2: Deep, dark-colored fine sandy loam soils on gently sloping upland.
    Unit IIIe-3: Deep, dark-colored loamy soils on nearly level upland.
Class IV.—Soils that can be used for crops but that have very severe limitations that restrict the choice of plants, require very careful management, or both.
  Subclass IVe: Soils that have a severe risk of erosion if they are cultivated and not protected.
    Unit IVe-1: Deep, light-colored loamy fine sand soils on rolling upland.
    Unit IVe-2: Deep, moderately dark and light colored loamy soils on gently sloping and sloping upland.
    Unit IVe-3: Deep, dark-colored loamy fine sand soils on nearly level to gently sloping upland.
  Subclass IVw: Soils that are affected by excess water.
    Unit IVw-1: Deep, dark-colored soils in shallow depressions of the upland.
Class VI.—Soils that have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, to woodland, or to wildlife habitats.
  Subclass VIe: Soils that are subject to severe erosion if not protected.
    Unit VIe-1: Deep, light-colored loamy soils on moderately steep and rolling upland.
    Unit VIe-2: Deep, light-colored loamy fine sand soils on rolling and hilly upland.
    Unit VIe-3: Deep, light-colored fine sandy loam soils on moderately steep upland.
Class VII.—Soils that have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife habitats.
  Subclass VIIe: Soils that are subject to very severe erosion.
    Unit VIIe-1: Deep, loose sandy soils on hilly upland and in blown-out areas.
  Subclass VIIw: Soils affected by excess water.
    Unit VIIw-1: Soils on flood plains and in stream channels.

Management of Dryland

A system of soil management consists of a combination of practices used to produce crops. A good system should maintain and improve the productivity of the soil.

In Stevens County, conservation of moisture is of first importance in management. Even when all moisture-conservation practices are applied, only 30 to 35 percent of the precipitation that falls during the growing period is used by crops. The efficiency of moisture storage dur-

ing the fallow period for wheat averages only about 15 to 20 percent. In other words, if a total of 5 or 6 inches of precipitation occurs, only about 1 inch is stored in the soil.

Control of wind erosion is also important to good management. The best time to control wind erosion is "the year before it happens." It is cheaper, easier, and more practical to prevent wind erosion than to control it after it has started. Methods of controlling wind erosion are:

1. Long-time practices, such as seeding land unsuitable for cultivation to perennial grasses to obtain permanent cover.
2. Seasonal practices, such as residue management.
3. Emergency measures, such as emergency tillage.

The conservation of soil and water is best obtained through a combination of management practices. A single practice may reduce erosion and conserve some moisture, or it may do both, but it is seldom enough for complete conservation.

The following are some management practices that maintain and improve soil productivity.

Cropping system.—A cropping system is a sequence of crops grown on a given area of soil over a period of time. It may consist of a regular rotation of different crops, grown in a definite order, or of the same crop, grown year after year. Some cropping systems may include different crops but lack a definite and planned order in which the crops are grown. The cropping sequences used in this county are wheat-fallow, sorghum-fallow-wheat, and continuous sorghum.

Fallowing is usually essential for economical production of wheat. The land must be managed so that soil moisture accumulates for about 14 months before the seeding of the crop.

A flexible cropping system on silt loams, loams, and fine sandy loams, used principally for wheat, is shown in table 2. (Fine sandy loams may be cultivated continuously to sorghum, and loamy fine sands generally are cultivated to continuous sorghum.) This cropping system can be used as a guide in planning more stable production.

In this system, it is necessary to determine the depth of moist soil and the condition of the soil cover. June 1, July 15, and September 1 have been selected as the approximate dates for determining these factors. If the depth of moist soil is less than 24 inches at planting time, crops are planted primarily for protective cover. A field has adequate cover if growing plants or residue (or both), together with proper soil texture, cloddiness, and surface roughness, will keep erosion at a minimum. Otherwise, the field has inadequate cover.

Residue management.—This is a year-round system of managing plant residue to protect the soil. Tilling, planting, and harvesting are so managed that enough residue is kept on the surface of the soil at all times. Some of the advantages of residue management are:

1. Effective and economical control of wind erosion.
2. Reduction of water erosion.
3. Maintenance of the peak rate of water intake by reducing the tendency of the soils to form surface-sealing crusts.
4. Decrease in loss of organic matter.
5. Slightly higher yields of crops.

Residue management should be practiced on all cultivated soils (fig. 10). The amount of residue needed to protect the soil varies according to the kind of residue and the texture of the surface soil.

TABLE 2.—*A flexible cropping system on silt loams, loams, and fine sandy loams, where wheat is the principal crop and needed conservation practices are used* [1]

Date	Depth of moist soil	Adequate cover on field	Inadequate cover on field
	Inches		
June 1	Less than 24	Manage soil until the depth of moist soil is 24 inches; then plant sorghum or manage until July 15.	Manage soil until the depth of moist soil is 24 inches; then plant sorghum or roughen surface and manage until July 15.
	More than 24	Plant sorghum or manage for wheat.	Plant sorghum, or roughen surface and manage for wheat.
July 15	Less than 30	Manage soil for wheat and expect to seed wheat primarily for a cover crop but possibly for a grain crop; be ready to plant wheat any time after Aug. 20, if the soil contains enough moisture.	Plant sorghum for a cover crop, or plant early maturing grain sorghum.
	More than 30	Manage soil for wheat with the expectancy of a grain crop.	Manage soil for wheat and expect to seed wheat primarily for a cover crop but possibly for a grain crop.
Sept. 1	Less than 36	Plant wheat with the expectancy of a grain crop (the soil should be moist to a depth of at least 24 inches at seeding time); if there is not enough moisture for seeding of wheat, manage for crop production in the next year.	Plant wheat for a cover crop but possibly for a grain crop; if there is not enough moisture for seeding of wheat, roughen surface and manage for sorghum or wheat to be grown in the next year.
	More than 36	Plant wheat with the expectancy of a grain crop; if moisture conditions in the surface soil are unfavorable for seeding of wheat, manage for crop production in the next year.	Plant wheat for a cover crop but possibly for a grain crop; if moisture conditions in the surface soil are unfavorable for seeding wheat, roughen surface and manage for sorghum to be grown in the next year.

[1] Prepared by FRED MEYER, JR., work unit conservationist, Syracuse, Kans.

Figure 10.—**Wheat has been planted in stubble on this field of Richfield silt loam, 0 to 1 percent slopes. About 1,000 pounds of residue per acre is still on the surface.**

The minimum amount of residue required to stabilize soils of various textures when a crop is planted is as follows:

	Pounds per acre of wheat residue	*Pounds per acre of sorghum residue*
Coarse-textured soils	1, 750	2, 500
Sand		
Loamy sand		
Loamy fine sand		
Moderately coarse and fine textured soils	1, 250	2, 000
Fine sandy loam		
Sandy loam		
Silty clay		
Clay		
Medium and moderately fine textured soils	750	1, 500
Loam		
Silt loam		
Silty clay loam		
Clay loam		
Sandy clay loam		

Residue should not be burned. Also, grazing of residue is not advisable, particularly on loamy fine sands. If residue is grazed, no less than the minimum amount, as shown in the list just given, should be maintained on the field.

Tillage implements best suited for residue management of wheat stubble are those that undercut the stubble and leave most of it on the surface. After four operations, these implements usually leave more than 40 percent of the residue on the surface. The first tillage operation in the spring should be done after weeds start to grow. The next will be needed after there is another growth of weeds. A rodweeder is often best for the last tillage before the drilling of wheat. It will kill small weeds and firm the seedbed.

Undercutting implements are suitable for the first tillage in the spring if grain sorghum is to be grown. A lister-type implement equipped with a planter is usually used to plant grain sorghum, particularly if sorghum is grown continuously. On sandy soils the preparation of the seedbed should be delayed until late in spring to keep as much sorghum residue on the surface as possible.

There is no substitute for a good cover of growing crops or crop residue. The soils need a cover throughout the year.

578561—61——2

Tillage.—This practice is the mechanical movement and mixing of the surface layer to make the soil favorable for the growth of crops. The primary purposes of tillage are to prepare the seedbed, to control weeds, and to manage crop residue. All tillage operations should help produce and maintain good tilth, or physical condition, of the surface soil. In Stevens County, tillage is the principal means by which a farmer carries out his soil management program.

Minimum tillage is the tilling of the soil only when it is necessary to break up a surface crust, to control weeds, or to prepare a seedbed. Too much tillage breaks down the granulation of the soil and destroys the crop residue, leaving the soil bare.

Emergency tillage consists of one or more tillage operations to roughen the surface of the soil and make it less susceptible to blowing. It should be done before or just after the soils begin to blow. Fields should be tilled from east to west, starting on the windward edge of an area subject to blowing.

Emergency tillage is most effective on soils in which the texture of the surface layer is loam or finer. On soils with loamy fine sand surface layers, emergency tillage is ineffective or, at best, effective only for a short time. Figure 11 shows the use of emergency tillage on a silt loam.

Contour farming.—In contour farming the soil is tilled parallel to terraces or contour guidelines. As a result, furrows, ridges, and wheel tracks are nearly level. The furrows and ridges hold much of the rainwater where it falls and thus decrease runoff and erosion. Yields of crops increase because more water is absorbed by the soil and made available to crops.

Contour farming is most effective when used with other conservation measures, such as residue management, terracing, and contour stripcropping.

Terracing.—This practice consists of the construction of ridges across the slope to intercept runoff water. In Stevens County, terraces are built without grade. They are sometimes called level terraces. On sloping fields, terraces help to control erosion, as well as to conserve moisture. On nearly level fields, terraces are used mainly to conserve moisture (fig. 12).

Figure 11.—**Emergency tillage, on the contour, on a silt loam soil.**

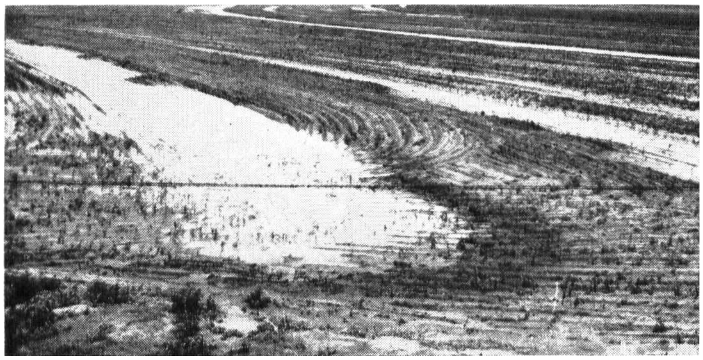


Figure 12.—Water retained by terraces on a nearly level field.

Contour farming and other conservation measures should be used along with terracing. Each row that is planted on the contour between terraces acts as a miniature terrace; it holds back some water and lets it soak into the soil. When terracing and contouring are used together, yields are increased and soil losses are decreased.

The horizontal distance needed between terraces depends largely on the slope. Since much of the rainfall is intensive, the terrace system protects other conservation practices.

Stripcropping.—This is a system of growing suitable crops in narrow strips on the same field. Strips of erosion-resistant crops or their residue are alternated with strips of other crops or with fallowed strips. Good stands of wheat and sorghum and their thick, heavy stubble are considered erosion resistant. Stripcropping helps control wind erosion by shortening the distance that loose soil can move. It provides a barrier of growing crops to reduce water erosion.

Two types of stripcropping are (1) contour stripcropping and (2) wind stripcropping. Contour stripcropping is used on sloping fields to help control both wind and water erosion. The strips are arranged on the contour; terraces or contour guidelines are used to establish the pattern.

Wind stripcropping is used on nearly level fields (fig. 13) where water erosion is not a problem and on some sloping fields where the slopes are so complex that farming on the contour is not practical. The strips are uniform in width, are usually straight, and extend from east to west. The width of the strip necessary to control soil blowing varies according to the kind of soil. On silt loams, loams, and clay loams, the maximum width between strips should be 20 rods. On sandy loams, the maximum width should be 10 rods.

Stripcropping will reduce soil blowing but does not completely control it when used alone. It is most effective when used with other needed conservation practices.

Management by capability units (dryland)

In this section the soils of Stevens County are grouped in capability units for dryland farming. The significant features of the soils in each capability unit, together with their hazards and limitations, are described. Suggestions for use and management of the soils of each unit are also given.

CAPABILITY UNIT IIIc-1

This unit consists of deep, dark-colored soils of the nearly level upland. The texture of the surface soils and subsoils is mainly silt loam, loam, or clay loam. The soils in this unit are:

Mansic clay loam, 0 to 1 percent slopes (Ma).
Richfield loam, thick surface, 0 to 1 percent slopes (Ra).
Richfield silt loam, 0 to 1 percent slopes (Rm).
Richfield-Ulysses loams, 0 to 1 percent slopes (Rx).
Ulysses silt loam, 0 to 1 percent slopes (Ua).

These soils have a high moisture-holding capacity and are easily penetrated by plant roots. Conservation of moisture and control of wind erosion are problems.

Wheat and grain sorghum are suitable crops. The cropping sequence used is wheat-fallow or sorghum-fallow-wheat.

Storage of moisture through fallowing is essential for profitable crop yields. Residue management and minimum tillage are needed to control wind erosion and help to conserve moisture. Contour farming and stripcropping also may be used. Terraces will help to conserve moisture. The soils of this unit are in the Loamy Upland range site.

CAPABILITY UNIT IIIc-2

Only one soil is in this capability unit. It is a deep, dark-colored soil that occurs on small flood plains along the North Fork of the Cimarron River. It has silt loam to clay loam surface soil and subsoil. The soil in this unit is:

Goshen silt loam (Go).

This soil has high moisture-holding capacity and is easily penetrated by plant roots. At times, it receives some extra moisture as runoff from surrounding areas. Conservation of moisture and control of wind erosion are problems.

Wheat and grain sorghum are suitable crops. A suitable cropping sequence is wheat-fallow or sorghum-fallow-wheat.

Storage of moisture through fallowing is essential for profitable crop yields. Residue management and minimum tillage are needed to control wind erosion and help to conserve moisture. The soil in this unit is in the Loamy Upland range site.

Figure 13.—Wind stripcropping on Richfield-Ulysses loams, 0 to 1 percent slopes.

CAPABILITY UNIT IIIe-1

This unit is made up of deep, moderately dark colored soils on gently sloping upland. The surface soils and subsoils are silt loam to clay loam. The soils in this unit are:

Mansic clay loam, 1 to 3 percent slopes (Mb).
Ulysses silt loam, 1 to 3 percent slopes (Ub).

These soils have a high moisture-holding capacity and are easily penetrated by plant roots. Conservation of moisture and control of wind and water erosion are problems.

Wheat and grain sorghum are suitable crops. The cropping sequence used is wheat-fallow or sorghum-fallow-wheat.

Storage of moisture through fallowing is essential for profitable crop yields. Residue management and minimum tillage will help to control wind and water erosion and to conserve moisture. Contour stripcropping also may be used. Terracing and contour farming are other practices needed. The soils in this unit are in the Loamy Upland range site.

CAPABILITY UNIT IIIe-2

This unit is made up of deep, dark-colored soils. These soils occur on the gently sloping upland. They have fine sandy loam surface soils and sandy loam to sandy clay loam subsoils. The soils in this unit are:

Dalhart fine sandy loam, 1 to 3 percent slopes (Db).
Manter fine sandy loam, 0 to 3 percent slopes (My).

These soils have a moderate to high moisture-holding capacity and are easily penetrated by plant roots. Conservation of moisture and control of wind and water erosion are problems.

Grain sorghum and wheat are suitable crops. The cropping sequence used is wheat-fallow, sorghum-fallow-wheat, or continuous sorghum.

Storage of moisture through fallowing is usually essential for profitable yields of wheat. Residue management and minimum tillage are needed to control water and wind erosion and to help conserve moisture. Contour farming and stripcropping also may be used. Terraces may be constructed to control water erosion and to help conserve moisture. The use of nitrogen fertilizer is economical during years when rainfall is above normal. Crop residue should not be grazed. After a new crop is planted, at least 1,250 pounds of wheat residue or 2,500 pounds of sorghum residue are needed to prevent wind erosion. The soils in this unit are in the Sandy range site.

CAPABILITY UNIT IIIe-3

This unit consists of a deep, dark-colored soil. This soil occurs on nearly level upland. It has fine sandy loam to loam surface soil and sandy clay loam subsoil. The soil in this unit is:

Dalhart fine sandy loam, 0 to 1 percent slopes (Da).

This soil has a high moisture-holding capacity and is easily penetrated by plant roots. Conservation of moisture and control of wind erosion are problems.

Wheat and grain sorghum are suitable crops. The cropping sequence is wheat-fallow or sorghum-fallow-wheat. Grain sorghum is grown several years in succession when rainfall is above normal.

Storage of moisture through fallowing is usually essential for profitable crop yields. Residue management and minimum tillage are needed to control wind erosion and to help conserve moisture. Contour farming and stripcropping also may be used. Terraces can be constructed to help conserve moisture. For the prevention of wind erosion, the soil needs about 1,000 to 1,250 pounds of wheat residue on the surface after a new crop has been seeded. The soil in this unit is in the Sandy range site.

CAPABILITY UNIT IVe-1

Only one soil is in this capability unit. It is a deep, light-colored soil that occurs on the rolling upland. It has a loamy fine sand surface soil and sandy loam subsoil. The soil in this unit is:

Vona loamy fine sand (Vo).

This soil has a moderate to low moisture-holding capacity. Wind erosion is the major problem, and the soil is therefore poorly suited to crops.

Sorghum can be grown. The cropping sequence is usually continuous sorghum.

Residue management and minimum tillage are needed to control wind erosion. The use of nitrogen fertilizer is usually economical. Crop residue should not be grazed but should be left on the surface for protection against wind erosion. Many areas should be seeded to native grasses and used for pasture. This soil is in the Sands range site.

CAPABILITY UNIT IVe-2

This unit is made up of deep, moderately dark and light colored soils. These soils occur on gently sloping and sloping upland. They have silt loam or loam surface soils and subsoils. The soils in this unit are:

Ulysses silt loam, 3 to 5 percent slopes (Uc).
Ulysses-Colby complex, 1 to 3 percent slopes, eroded (Ue).

These soils have a high moisture-holding capacity. Conservation of moisture and control of wind and water erosion are problems. The soils are not well suited to cultivated crops. Wheat and grain sorghum are grown, however. The cropping sequence used is wheat-fallow or sorghum-fallow-wheat.

Storage of moisture through fallowing is essential for profitable crop yields. Residue management and minimum tillage are needed to help control wind and water erosion and to conserve moisture. Terracing, contour farming, and stripcropping are also needed. Some areas should be seeded to native grasses and used for pasture. The soils in this unit are in the Loamy Upland range site.

CAPABILITY UNIT IVe-3

This unit consists of deep, dark-colored soils. These soils occur on nearly level to gently sloping upland. They have mainly loamy fine sand surface soils and sandy clay loam to clay loam subsoils. The soils in this unit are:

Dalhart loamy fine sand, 0 to 3 percent slopes (Df).
Dalhart-Otero fine sandy loams (Dx).
Richfield loamy fine sand, 0 to 1 percent slopes (Rb).

These soils have a high moisture-holding capacity and are easily penetrated by plant roots. Wind erosion is the major problem.

Sorghum is a suitable crop. Continuous sorghum is usually grown.

Residue management and minimum tillage are needed to control wind erosion. The use of nitrogen fertilizer is usually economical. Crop residue should not be grazed but should be left on the surface to protect the soils from wind erosion. Dalhart loamy fine sand, 0 to 3 percent slopes, and Richfield loamy fine sand, 0 to 1 percent slopes, are in the Sands range site. Dalhart-Otero fine sandy loams are in the Sandy range site.

CAPABILITY UNIT IVw-1

This unit consists of deep, dark-colored soils that occupy shallow upland depressions where water is ponded for several days after rainstorms. The soils in this unit are:

Lofton clay loam (Lo).
Lofton fine sandy loam (Lp).

These soils have a high moisture-holding capacity and very slow permeability. Wetness caused by ponding of water is the major problem.

These soils are usually managed like the surrounding soils. Terraces may be used on surrounding soils to keep excess water out of the depressions. Residue management and minimum tillage should be used to control wind erosion. Lofton clay loam is in the Loamy Upland range site, and Lofton fine sandy loam is in the Sandy range site.

CAPABILITY UNIT VIe-1

This unit is made up of deep, moderately dark and light colored soils. These soils occur on moderately steep and rolling upland. They have loam to clay loam surface soils and subsoils. The soils in this unit are:

Colby loam, 5 to 12 percent slopes (Cm).
Mansic-Otero complex (Mx).

These soils have a high moisture-holding capacity. They are generally calcareous at the surface. Both wind and water erosion are hazards.

Because of the erosion hazard, these soils are best suited to native grass pasture. Grassland management practices needed on these soils are given under the Loamy Upland range site.

CAPABILITY UNIT VIe-2

This unit consists of deep, light-colored sandy soils. These soils occur on the rolling or hilly upland. They have loamy fine sand surface soils and loamy fine sand to sandy loam subsoils. This unit is made up of the following soil complex:

Vona-Tivoli loamy fine sands (Vx).

These soils have a low moisture-holding capacity. Wind erosion is a serious hazard. A cover of native vegetation should be maintained to protect the soils from blowing.

These soils are best suited to native grass pasture. Grassland management practices needed on these soils are given under the Sands range site.

CAPABILITY UNIT VIe-3

Only one soil is in this capability unit. It is a deep, light-colored soil that occurs on moderately steep upland. It has a fine sandy loam surface soil and subsoil. The soil in this unit is:

Otero fine sandy loam, 5 to 12 percent slopes (Ot).

This soil has a moderate moisture-holding capacity. It is generally calcareous at the surface. Both wind and water erosion are hazards.

Because of the erosion hazard, this soil is best suited to native grass pasture. The areas that are now cultivated should be seeded to suitable native grasses and used for pasture. Grassland management practices needed on this soil are given under the Sandy range site.

CAPABILITY UNIT VIIe-1

This unit is made up of deep, loose, sandy soils that occur on the hilly upland and in blown-out areas. It is comprised of the following:

Blown-out land (Bo).
Tivoli fine sand (Tf).

The soils are suited only to limited use as native grass pasture. Blown-out land must be revegetated if used for pasture. Grazing is limited on the Tivoli fine sand in order to maintain the plant cover; otherwise, this soil will become Blown-out land or active sand dunes. Grassland management practices needed on these soils are given under the Choppy Sands range site.

CAPABILITY UNIT VIIw-1

This unit consists of soils that occupy the flood plains of the Cimarron River and the channel of the North Fork of the Cimarron River. They are:

Broken land (Bx).
Lincoln soils (Lf).

Because of flooding, the vegetation on these areas is sparse and unstable. The areas are suited only to limited use as native grass pasture. Consult a local representative of the Soil Conservation Service for more information about management of these areas. Lincoln soils and Broken land are not placed in range sites because of the instability of the soil material and the vegetation.

Management of Irrigated Soils

In 1958, about 34,000 acres were being irrigated in Stevens County, and probably about 41,000 more acres could be brought under irrigation. An additional 75,000 acres of nearly level soil could also be irrigated if water were available. The two general methods used to apply water in Stevens County are gravity irrigation and sprinkler irrigation.

Source of irrigation water.—Irrigation water is obtained from deep wells. The first irrigation well in the county was drilled in 1934. By 1958, there were 114 irrigation wells. More than half of these were drilled in 1955 and 1956. Internal combustion engines, which use natural gas for fuel, supply power for turbine pumps that lift the water. The water is lifted from depths ranging from about 140 to 250 feet. Underlying water-bearing formations are continuous throughout the county. Test wells must be drilled, however, to determine the quantity of water that can be obtained at a particular location. The water is excellent for irrigation if it is obtained from the underlying Pliocene and Pleistocene deposits. (See fig. 17 in the section "Genesis and Morphology of the Soils.")

Suitability of the soils for irrigation.—Some of the soils in the county are well suited to irrigation. (See the "Guide to Mapping Units, Capability Units, and Range Sites" at the back of the report.) The irrigable soils are deep and have adequate moisture-holding capacity. Their

permeability is moderate to moderately slow, and internal drainage is good. Before they can be irrigated, most of the soils need to be leveled so that the distribution of water will be uniform. The soils are fertile, and, at present, nitrogen is the only plant nutrient needed for peak yields of crops. Management of the soils suited to irrigation is discussed under "Management by Capability Units (Irrigated)."

Crops grown on irrigated soils.—The principal crops grown on the irrigated soils are wheat and grain sorghum. The cropping sequence generally used is wheat and grain sorghum, but either may be grown continuously. Many other crops could be grown if better marketing facilities were available in the county. Corn, peanuts, cantaloups, and castorbeans have been grown on trial plots. Also, a few acres have been used for seed production of native grasses, alfalfa, and forage sorghum.

Planning an irrigation system.—If a farmer plans to irrigate his land, he should consider the following: (1) The suitability of the soils for irrigation; (2) the adequacy, reliability, and quality of the water supply; (3) the control and conveyance of water; (4) the total water requirements based on amount of water used by crops, amount of effective rainfall, and the efficiency of the irrigation system; (5) the method of applying water; and (6) the drainage facilities needed to remove excess surface and subsurface water. For further information about irrigating a specific farm, consult the local representative of the Soil Conservation Service.

Management by capability units (irrigated)

In this section the irrigable soils of Stevens County have been placed in capability units. The soils in a capability unit have about the same limitations and risk of damage when used for irrigation. Management practices suitable for the soils in each unit are discussed.

CAPABILITY UNIT I-1 (IRRIGATED)

The soils of this unit occur on nearly level upland. They have loam to clay loam surface soils and subsoils. These fertile soils are deep and have moderately slow permeability. They have a high moisture-holding capacity and are well drained. The soils in this unit are:

Goshen silt loam (Go).
Mansic clay loam, 0 to 1 percent slopes (Ma).
Richfield silt loam, 0 to 1 percent slopes (Rm).
Richfield loam, thick surface, 0 to 1 percent slopes (Ra).
Richfield-Ulysses loams, 0 to 1 percent slopes (Rx).
Ulysses silt loam, 0 to 1 percent slopes (Ua).

Good management of these soils includes the following practices that maintain or improve fertility and tilth: (1) Use of a crop rotation that includes a deep-rooted legume; (2) use of green-manure crops and crop residue; and (3) application of commercial fertilizer as needed. Land leveling is usually needed to obtain efficient use of water and a better irrigation system. A system for the removal of excess irrigation water and runoff from rainstorms is essential. For further information on irrigation and related engineering problems, consult the local representative of the Soil Conservation Service.

CAPABILITY UNIT I-2 (IRRIGATED)

The soil in this capability unit occurs on nearly level upland. It has a fine sandy loam surface soil and a sandy clay loam to clay loam subsoil. This fertile soil is deep and has moderately slow permeability. It has a high moisture-holding capacity and is well drained. This soil does not have as much moisture-holding capacity in the top 2 feet as the soils in unit I-1. The only soil in this unit is:

Dalhart fine sandy loam, 0 to 1 percent slopes (Da).

Good management of this soil includes the following practices that maintain or improve fertility and tilth: (1) Use of a crop rotation that includes a deep-rooted legume; (2) use of green-manure crops and crop residue; and (3) application of commercial fertilizer as needed. Land leveling is usually required to provide efficient use of water and a better irrigation system. A system for the removal of excess irrigation water and runoff from rainstorms is essential. For further information on irrigation and related engineering problems, consult the local representative of the Soil Conservation Service.

CAPABILITY UNIT IIe-1 (IRRIGATED)

The soils in this unit occur on gently sloping upland. They have silt loam to clay loam surface soils and subsoils. These fertile soils are deep and have moderately slow permeability and high moisture-holding capacity. They are subject to water erosion. The soils in this unit are:

Mansic clay loam, 1 to 3 percent slopes (Mb).
Ulysses silt loam, 1 to 3 percent slopes (Ub).

Good management of these soils must provide for erosion control, efficient use of water, and maintenance of fertility and tilth. Land leveling, contour-furrow irrigation, and other practices that minimize the danger of erosion are needed. Drop structures are usually necessary to control erosion of the irrigation ditches. A system for the removal of excess irrigation water and runoff from rainstorms is essential. For further information about irrigation, consult the local representative of the Soil Conservation Service.

CAPABILITY UNIT IIe-2 (IRRIGATED)

The soils in this unit occur on gently sloping upland. They have fine sandy loam surface soils and fine sandy loam to sandy clay loam subsoils. These fertile soils are deep and have moderate permeability and a moderate to high moisture-holding capacity. They are subject to water and wind erosion. The soils in this unit are:

Dalhart fine sandy loam, 1 to 3 percent slopes (Db).
Manter fine sandy loam, 0 to 3 percent slopes (My).

Good management of these soils must provide for erosion control, efficient use of water, and maintenance of fertility and tilth. Land leveling and other suitable practices are needed. A system for the removal of excess irrigation water and runoff from rainstorms is essential. Distributing water through pipes will eliminate the loss of water that occurs in open irrigation ditches. For further information about irrigation, consult the local representative of the Soil Conservation Service.

CAPABILITY UNIT IIIe-4 (IRRIGATED)

The soils in this unit occur on nearly level to gently sloping and undulating upland. They have loamy fine sand to fine sandy loam surface soils and sandy clay loam

to clay loam subsoils. These fertile soils are deep and have moderate permeability and a high moisture-holding capacity. They are subject to wind and water erosion. The soils in this unit are:

Dalhart-loamy fine sand, 0 to 3 percent slopes (Df).
Dalhart-Otero fine sandy loams (Dx).
Richfield loamy fine sand, 0 to 1 percent slopes (Rb).

Good management of these soils must provide for erosion control, efficient use of water, and maintenance of fertility. Some of the soils on smooth slopes may be suitable for flood irrigation, but the rest must be irrigated with sprinklers. Most of the areas are uneven or undulatding. For further information about irrigation, consult the local representative of the Soil Conservation Service.

CAPABILITY UNIT IVe-4 (IRRIGATED)

Only one soil is in this capability unit. It occurs on rolling upland. It has a loamy fine sand surface soil and sandy loam subsoil. This soil is deep and has moderate permeability and a moderate to low moisture-holding capacity. It is highly susceptible to wind erosion. The soil in this unit is:

Vona loamy fine sand (Vo).

Good management of this soil must provide for erosion control, efficient use of water, and maintenance of fertility. Sprinkler irrigation is the only practical type of irrigation. Tame grasses probably are the most suitable crop. For further information about irrigation, consult the local representative of the Soil Conservation Service.

Productivity of the Soils

This section is mainly about the productivity of the soils used for dryland farming, the predominant type of agriculture. Some information on productivity of soils used for irrigation farming is also included.

Crop yields in Stevens County depend largely on the climate. Yields of wheat and grain sorghum range from 0 to 50 bushels per acre, usually depending on the amount of rainfall that occurs. Crop yields are also affected by diseases, insects, fertility of the soil, and differences in soil management.

Because of the dry climate, over a long period a yearly average of about 30 percent of the acreage planted to wheat is abandoned. Table 3 gives statistics on the acreages and yields per acre of wheat and grain sorghum in stated years. Most of the farms in the county are large and employ low-cost methods. The expenditure per acre is low, and crop production, therefore, can be profitable even though yields per acre are relatively low.

Dryland yields

Estimated yields per planted acre of dryland wheat and grain sorghum are given for the arable soils in table 4. Estimated yields of wheat reflect the general use of a fallow period. Because no areas of Goshen silt loam are being farmed in the county, estimated yields are not given for this soil.

The estimated yields are based on limited information. Therefore, the figures given in the table are predictions of average yields that may be expected over a period of many years. They are considered reliable enough to be of value in farm planning, however.

TABLE 3.—*Acreages and yields of wheat and grain sorghum, 1925–58* [1]

Year	Wheat				Grain sorghum	
	Acres planted	Acres harvested	Acres abandoned	Yield per acre harvested	Acres harvested	Yield per acre
			Percent	*Bu.*		*Bu.*
1925	92, 473	61, 032	34	3. 0	69, 174	11. 8
1926	112, 592	101, 333	10	20. 8	64, 559	16. 9
1927	98, 952	5, 937	95	1. 0	95, 214	15. 3
1928	95, 562	66, 893	31	16. 0	76, 910	17. 2
1929	137, 947	131, 050	5	17. 0	57, 417	18. 6
1930	161, 033	131, 204	19	7. 0	44, 273	12. 7
1931	172, 154	166, 989	4	20. 0	61, 531	15. 4
1932	102, 604	51, 302	50	7. 0	56, 260	5. 6
1933	105, 450	9, 490	91	5. 9	52, 474	6. 2
1934	140, 525	77, 289	45	4. 0	(2)	(2)
1935	125, 158	16, 271	87	3. 0	47, 348	2. 4
1936	125, 754	30, 181	76	5. 0	(2)	(2)
1937	153, 000	24, 500	85	4. 3	64, 080	3. 6
1938	80, 000	45, 600	44	6. 2	78, 940	5. 1
1939	107, 000	59, 000	45	5. 5	51, 540	4. 5
1940	61, 000	51, 000	17	7. 4	91, 780	10. 9
1941	82, 000	63, 100	24	10. 0	66, 330	16. 9
1942	106, 000	97, 000	9	15. 7	54, 190	16. 1
1943	108, 000	106, 000	2	13. 8	65, 140	14. 4
1944	111, 000	76, 000	31	16. 7	115, 620	26. 3
1945	130, 000	122, 000	7	17. 3	76, 270	15. 7
1946	136, 000	125, 000	9	16. 2	63, 160	14. 5
1947	149, 000	145, 000	3	19. 0	82, 140	15. 4
1948	151, 000	144, 000	5	18. 3	90, 930	22. 7
1949	157, 000	148, 000	6	15. 5	101, 000	23. 1
1950	127, 000	108, 000	15	8. 3	128, 210	15. 6
1951	143, 000	51, 000	65	8. 2	173, 750	20. 3
1952	124, 000	108, 000	13	16. 1	116, 600	6. 5
1953	127, 000	79, 000	38	6. 1	122, 100	10. 9
1954	119, 000	97, 000	19	8. 4	166, 900	18. 6
1955	101, 000	55, 000	46	10. 0	215, 200	15. 1
1956	98, 000	71, 000	28	9. 6	112, 600	10. 0
1957	21, 000	[3] 10, 000	53	25. 0	248, 000	17. 1
1958	99, 000	97, 000	2	29. 0	167, 000	19. 2

[1] Based on biennial reports of the Kansas State Board of Agriculture.
[2] Little or no grain harvested.
[3] Mostly irrigated wheat.

Under the present system of management, if the cropping sequence is sorghum, fallow, and wheat, these practices are followed:

1. The soil is tilled several times and is bare when the crop is planted.
2. The grain sorghum is planted too thick.

Under the prevailing system of management, if grain sorghum is grown continuously, these practices are followed:

1. The soil is tilled several times and is bare when the crop is planted.
2. The sorghum is planted too thick.
3. Most of the sorghum residue is grazed off.

Under improved management, if the cropping system is sorghum, fallow, and wheat, the following practices are used:

1. The soil is tilled only when necessary to control weeds and prepare the seedbed.

TABLE 4.—*Estimated average yields per acre of seeded wheat and grain sorghum on the arable soils under two levels of management.*

[Columns A show yields to be expected under present management, and columns B show yields to be expected under improved management. Wheat yields reflect the general use of summer fallow]

Soil	Wheat		Grain sorghum	
	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*
Dalhart fine sandy loam, 0 to 1 percent slopes	16.0	20.0	20.0	25.0
Dalhart fine sandy loam, 1 to 3 percent slopes	12.0	16.0	16.0	20.0
Dalhart loamy fine sand, 0 to 3 percent slopes	(1)	(1)	23.0	29.0
Dalhart-Otero fine sandy loams	(1)	(1)	16.0	20.0
Lofton clay loam	9.0	13.0	13.0	15.0
Lofton fine sandy loam	9.0	13.0	13.0	15.0
Mansic clay loam, 0 to 1 percent slopes	14.5	18.0	15.0	18.0
Mansic clay loam, 1 to 3 percent slopes	12.0	16.0	12.0	15.0
Manter fine sandy loam, 0 to 3 percent slopes	10.0	14.0	15.0	19.0
Richfield loamy fine sand, 0 to 1 percent slopes	(1)	(1)	24.0	30.0
Richfield loam, thick surface, 0 to 1 percent slopes	16.0	20.0	18.0	22.0
Richfield silt loam, 0 to 1 percent slopes	14.5	18.0	15.0	18.0
Richfield-Ulysses loams, 0 to 1 percent slopes	14.0	18.0	15.0	18.0
Ulysses-Colby complex, 1 to 3 percent slopes, eroded	10.5	14.5	11.0	13.0
Ulysses silt loam, 0 to 1 percent slopes	14.0	18.0	15.0	18.0
Ulysses silt loam, 1 to 3 percent slopes	11.5	16.0	12.0	14.5
Ulysses silt loam, 3 to 5 percent slopes	10.0	14.0	10.0	12.0
Vona loamy fine sand	(1)	(1)	13.0	20.0

[1] Little or no wheat grown.

2. Terracing, contouring, and stripcropping are used to help control erosion and to conserve moisture.
3. Tillage implements that leave residue on the surface of the soil are used.
4. Wheat and grain sorghum are planted only if the soil is moist to a depth of more than 24 inches.
5. Two pounds of grain sorghum per acre, or less, are planted.

Under improved management, if grain sorghum is grown continuously, the following practices are used:

1. The soil is tilled only to control weeds and to prepare a seedbed.
2. About 2½ pounds of grain sorghum per acre are planted.
3. Sorghum residue is not grazed.

Irrigated land yields

Wheat and sorghum are the major crops grown under irrigation, but yield information on different soils is limited. The present management of irrigated soils is considered an extensive type of management. It consists of watering as many acres as possible without leveling the land and of applying limited amounts of fertilizer.

Under improved irrigation management, average yields may be increased by about 100 percent. An improved system of management is considered intensive management. It consists of watering a few acres thoroughly, leveling the land for better distribution of water, and applying adequate amounts of fertilizer.

Range Management [2]

Rangeland makes up about 10 percent of the total area of Stevens County. It is scattered throughout the county, but some concentration of rangeland occurs along the Cimarron River in the northwestern part. Most of the rangeland is not suitable for cultivation.

The raising of livestock is the third largest agricultural industry in Stevens County. The success of the livestock industry depends on the way ranchers and farmers manage their range and other feed resources.

Principles and practices of range management

High forage production and the conservation of soil, water, and plants are obtained through the maintenance of range that is in good and excellent condition and through the improvement of range that is depleted. The vegetation is improved by managing the grazing so as to encourage the growth of the best native forage plants.

Leaf development, root growth, flower-stalk formation, seed production, forage regrowth, and food storage in roots are processes in the development and growth of grass. Range operators must allow these natural processes to take place if maximum yields of forage and peak production of livestock are to be maintained.

Livestock are selective in grazing and constantly seek the more palatable plants. If grazing is not carefully controlled, the better plants are eventually eliminated. Less desirable or second-choice plants increase. If heavy grazing is continued, even the second-choice plants will be thinned out or eliminated and undesirable weeds or invaders will take their place.

Research by agricultural workers and experience by ranchers have shown that when only about half the yearly total growth of grass is removed by grazing, damage to the desirable plants is minimized, and the range is maintained or improved. The grass that is left to grow has the following effect on the range:

1. It serves as a mulch that permits rapid intake and storage of water; the more water stored in the soil, the better the growth of grass the following season.
2. It allows roots to increase in number and length and thus to reach additional moisture and plant nutrients. Overgrazed grass cannot reach deep moisture because not enough green shoots are left to provide the food needed for good growth of roots.
3. It provides the best kind of cover to protect the soil from wind and water erosion.
4. It allows the better grasses to maintain or improve their vigor and thus crowds out or prevents weeds.
5. It enables plants to store food for quick and vigorous growth after droughts and in spring.

[2] By PETER N. JENSEN, range conservationist, Soil Conservation Service, Dodge City, Kans.

6. It stops snow where it falls so that it melts and soaks into the soil for later use.
7. It provides a greater feed reserve for the dry years; otherwise, livestock may have to be sold.

Sound range management requires adjustment in stocking rates from season to season according to the amount of forage produced. Range management should provide for reserve pastures or other feed during droughts or other periods of low forage production. Thus, the range forage can be grazed moderately at all times. In addition, it often is desirable to keep part of the livestock, such as stocker steers, readily salable. If this is done, the rancher can adjust the number of livestock to the amount of forage produced without the sale of breeding animals.

Management practices that cost little and that are needed to improve all rangeland are defined as follows:

Proper range use.—This is the practice of grazing rangeland at a rate that will maintain vigorous plants, forage reserves, and enough residue to conserve soil and water. In addition, this practice helps to maintain the most desirable vegetation or to improve the quality of vegetation that has deteriorated.

Deferred grazing.—This is the periodic postponement of grazing on a given range. It is used to allow the desirable plants to increase in vigor and number, free from grazing pressure. In addition to improving the range, deferred grazing helps to build up a reserve of range forage for later use.

Rotation-deferred grazing.—This is a practice by which one or more pastures are rested at planned intervals throughout the growing season. Each pasture is given a different rest period each successive year to permit the desirable forage plants to develop and produce seed every second, third, or fourth year.

Following is a list of practices that improve range and help to control movement of livestock.

1. *Range seeding.*—This is the establishment, by seeding or reseeding, of native or improved dominant grasses on land suitable for use as range. The area to be seeded should have a climate and soil that naturally support range plants so that only management of grazing is needed to maintain forage. A mixture of native grasses that consists primarily of species dominant in the climax vegetation should be seeded. Strains of each species that are known to be suited to the area can be used. Only grass seed harvested within 250 to 400 miles south and 100 to 150 miles north of the county should be planted. Grass should be seeded in stubble of grain or forage sorghum. This type of cover protects the soil from erosion, provides a firm seedbed, and is relatively free from weeds; the mulch helps to retain moisture in the upper layer of soil. Newly seeded areas should not be grazed for at least 2 years so that the plants will have time to become firmly established.
2. *Use of water developments.*—Watering places should be located over the entire range, if possible, so that livestock do not have to go too far for water. Good distribution of water helps to achieve uniform use of the range. Generally, wells, ponds, and dugouts supply water for livestock, but in some places water must be hauled. The makeup of each range determines which type of water development is the most practical.
3. *Fencing.*—Fences should be constructed to separate the ranges that are used during different seasons. In some places different range sites are fenced if there is a great difference in the way they are used.
4. *Salting.*—This is necessary for livestock. Periodic moving of salt grounds will distribute grazing and promote more uniform use of the range.
5. *Weed and brush control.*—Chemical or mechanical means may be needed to control undesirable plants on some sites. This will improve range forage. Sand sagebrush is the dominant undesirable plant in the sandhills of Stevens County. Consult the local representative of the Soil Conservation Service for further information.

The management that will obtain high production of livestock and conserve range will—

1. Furnish enough feed and forage to keep livestock in good condition the year round. At appropriate times, and in suitable combinations, animals are grazed on the range, are fed concentrates and hay or harvested roughages, and are grazed on tame pasture. To guard against emergencies, surplus feed grown in good years is sorted in stacks, pits, or silos. Deferred grazing is practiced to allow grasses to make the growth that will protect the soils, conserve water, and provide reserve grazing.
2. Provide a breeding program that keeps on the range animals of the kind and age that make the best gains. Nonproductive animals are culled out and the herd is continually improved by selective breeding.

Range sites

Different kinds of range produce different kinds of grass or different amounts of grass or both. To manage rangeland properly, an operator should know the different kinds of land (range sites) in his holdings and the plants each site is capable of growing . He will then be able to use the management needed to produce the best forage plants on each site. Important terminolgy used in the discussion of rangeland is described next.

Range sites are areas of rangeland that produce significantly different kinds or amounts of climax, or original, vegetation. A significant difference is one great enough to require different grazing or other management practices to maintain or improve the present vegetation. *Climax vegetation* is the combination of plants that grew originally on a given site. The most productive combination of forage plants on rangeland is generally the climax type of vegetation.

Range condition is a term used in comparing the amounts and kinds of vegetation now on a range site with the amounts and kinds on it originally. The comparisons are made in percentages. A range site having its original, or climax, vegetation would have a rating of 100 percent, but few range sites have such a rating because their condition has been changed by a combination of grazing and drought. Consequently, four range condition classes are recognized, as follows:

Condition class	*Percentage of climax vegetation on the site*
Excellent	76 to 100
Good	51 to 75
Fair	26 to 50
Poor	0 to 25

The range sites in Stevens County are the Sandy, Sands, Choppy Sands, and Loamy Upland. The dominant sites—the Sands, Choppy Sands, and Sandy—make up nearly 90 percent of the rangeland.

The description of each range site includes the (1) names of the soils and the map symbol for each soil; (2) dominant vegetation on each site when it is in excellent condition; and (3) management practices needed to maintain and improve range condition.

In the descriptions of range sites, vegetation is referred to in terms of *increasers*, *decreasers*, and *invaders*. Decreasers and increasers are climax plants. Decreasers are the most heavily grazed and are consequently the first to be destroyed by overgrazing. Increasers withstand grazing better or are less palatable to the livestock; they increase under grazing and replace the decreasers. Increasers finally decrease also, if grazing pressure continues. Invaders are plants that become established after the climax vegetation has been reduced by grazing.

Yields for top growth of forage for range sites in excellent condition may be expected to vary with amounts of rainfall received each year. In addition, yields will be influenced by the amount of grazing use received in past years. Disappearance of forage, other than by grazing, is due to rodents, insects, trampling, and other causes. These factors vary from year to year and greatly affect the annual yield of forage.

Following is an estimate of the total top growth of forage for the range sites in excellent condition under average rainfall conditions:

Range site	*Air-dry weight (lb. per acre)*
Loamy Upland	1,250 to 2,000
Sands	2,000 to 2,500
Sandy	1,500 to 2,000
Choppy Sands	1,250 to 1,750

SANDY SITE

This range site is made up of deep soils on nearly level to moderately steep upland (fig. 14). The soils have fine sandy loam surface layers and sandy loam to clay loam subsoils. They are moderately permeable. Moisture-holding capacity is moderate to high. The soils in this range site and the map symbol of each are as follows:

Dalhart fine sandy loam, 0 to 1 percent slopes (Da).
Dalhart fine sandy loam, 1 to 3 percent slopes (Db).
Dalhart-Otero fine sandy loams (Dx).
Lofton fine sandy loam (Lp).
Manter fine sandy loam, 0 to 3 percent slopes (My).
Otero fine sandy loam, 5 to 12 percent slopes (Ot).

Decreaser grasses in the climax vegetation, such as sand bluestem, little bluestem, switchgrass, and side-oats grama, make up 55 percent of the plant cover. Other perennial grasses and forbs make up the rest. The dominant increaser grasses include blue grama, sand dropseed, buffalograss, and sand paspalum. Sand sagebrush and small soapweed are the dominant woody increasers. Common invaders are three-awns, windmillgrass, and six-weeks fescue.

Under present management this range site is generally in poor condition. In this condition it is producing approximately one-fourth of its potential in kind and amount of vegetation. The dominant vegetation is sand dropseed, sand sagebrush, sand paspalum, and blue grama.

Management practices needed to maintain or improve the site are proper range use, deferred grazing, and rotation-deferred grazing.

SANDS SITE

This range site is made up of deep soils on nearly level to undulating upland. The soils have loamy fine sand surface layers and loamy fine sand to clay loam subsoils. The moisture-holding capacity is low to high, depending on the texture of the subsoil. The soils in this range site and the map symbol of each are as follows:

Dalhart loamy fine sand, 0 to 3 percent slopes (Df).
Richfield loamy fine sand, 0 to 1 percent slopes (Rb).
Vona loamy fine sand (Vo).
Vona-Tivoli loamy fine sands (Vx).

Decreaser grasses in the climax vegetation, such as sand bluestem, little bluestem, switchgrass, side-oats grama, and big sandreed, make up about 65 percent of the plant cover. Other perennial grasses and forbs make up the rest. The dominant increaser grasses include blue grama, sand dropseed, and sand paspalum. Sand sagebrush is the principal woody invader. Common invaders are false buffalograss, purple sandgrass, and red lovegrass.

Under present management this range site is generally in poor condition. In this condition it is producing approximately one-fourth of its potential in kind and amount of vegetation. The dominant vegetation is sand dropseed, sand sagebrush, sand paspalum, and blue grama.

Management practices needed to maintain or improve the site are proper range use, deferred grazing, rotation-deferred grazing, and brush control.

CHOPPY SANDS SITE

This range site consists of deep fine sand soils that occupy steep, hummocky, and dunelike sandhills (fig. 15). Blowouts are numerous throughout the area. These soils have rapid permeability, are somewhat excessively drained, and are low in moisture-holding capacity. The

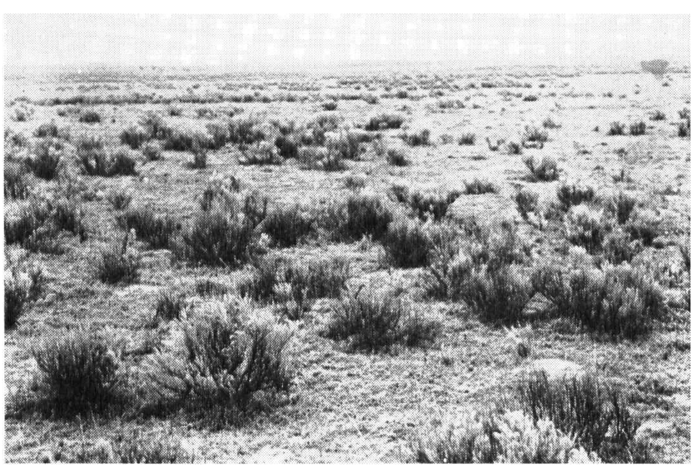


Figure 14.—Typical view of the Sandy range site.

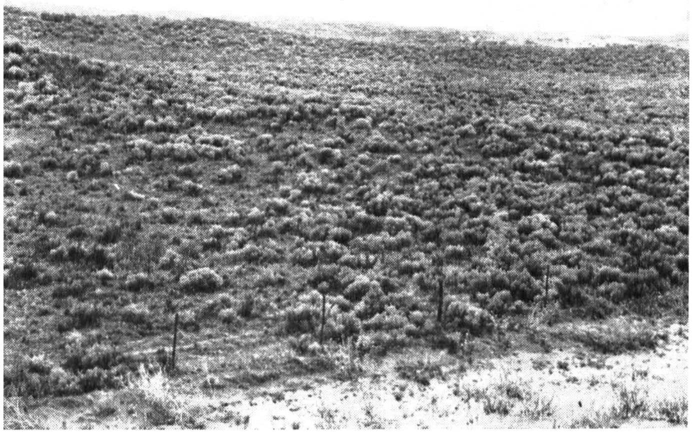


Figure 15.—Typical view of the Choppy Sands range site.

soils in this range site and the map symbol of each are as follows:

Blown-out land (Bo).
Tivoli fine sand (Tf).

Decreaser grasses in the climax vegetation, such as sand bluestem, switchgrass, little bluestem, and big sandreed, make up about 60 percent of the vegetation. Other perennial grasses and forbs make up the rest. The dominant increasers include such grasses as sand dropseed and sand paspalum. The principal woody plant is sand sagebrush. Blowoutgrass and big sandreed are the first perennial plants to stabilize blowouts or dunes. Common invaders are false buffalograss and purple sandgrass.

Under present management this range site is generally in poor condition. In this condition it is producing approximately one-fourth of its potential in kind and amount of vegetation. The dominant vegetation is sand dropseed, sand sagebrush, sand paspalum, and blue grama.

Management practices needed to maintain or improve the condition of the site are proper range use, deferred grazing, rotation-deferred grazing, and brush control. Because of the hazard of wind erosion, water developments and salting grounds should not be located on this site.

LOAMY UPLAND SITE

This range site consists of deep soils on nearly level to strongly sloping upland. The soils have loam to clay loam surface layers and subsoils. They are moderately permeable and have a high moisture-holding capacity. The soils in this range site and the map symbol of each are as follows:

Colby loam, 5 to 12 percent slopes (Cm).
Goshen silt loam (Go).
Lofton clay loam (Lo).
Mansic clay loam, 0 to 1 percent slopes (Ma).
Mansic clay loam, 1 to 3 percent slopes (Mb).
Mansic-Otero complex (Mx).
Richfield loam, thick surface, 0 to 1 percent slopes (Ra).
Richfield silt loam, 0 to 1 percent slopes (Rm).
Richfield-Ulysses loams, 0 to 1 percent slopes (Rx).
Ulysses-Colby complex, 1 to 3 percent slopes, eroded (Ue).
Ulysses silt loam, 0 to 1 percent slopes (Ua).
Ulysses silt loam, 1 to 3 percent slopes (Ub).
Ulysses silt loam, 3 to 5 percent slopes (Uc).

The climax vegetation is a mixture of such grasses as blue grama, buffalograss, western wheatgrass, side-oats grama, and little bluestem. Buffalograss is the main increaser when the site is heavily grazed. Blue grama and buffalograss are the dominant grasses under normal grazing. Annuals are the principal invaders. In droughty years, pricklypear is the most common invader. Figure 16 shows the Loamy Upland range site under contrasting management.

Under present management the Loamy Upland site is generally in fair to good condition. In this condition it is producing approximately half its potential in kind and amount of vegetation. The dominant grasses are blue grama and buffalograss.

Management practices needed to maintain or improve the condition of the range are proper range use, deferred grazing, and rotation-deferred grazing.

UNCLASSIFIED

The following mapping units are not true range sites because of the instability of the soil and the vegetation:

Broken land (Bx).
Lincoln soils (Lf).

These areas occupy the flood plains of the Cimarron River and the channel of the North Fork of the Cimarron River. Because of flooding and wind erosion, these areas have an unstable plant cover. The vegetation consists of switchgrass, side-oats grama, and annual weeds and grasses. Some cottonwood trees and annual forbs grow on the Lincoln soils.

Woodland Management

There are no native forests or woodlands in Stevens County. The flood plains along the Cimarron River support a sparse, mixed stand of cottonwood, tamarisk, and other trees and shrubs. Trees and shrubs grow well only in places that receive additional moisture. The only plantings in the county are farmstead windbreaks and trees grown for shade or ornament.

Windbreak plantings help protect farmsteads and feeding areas for livestock. They can be established suc-

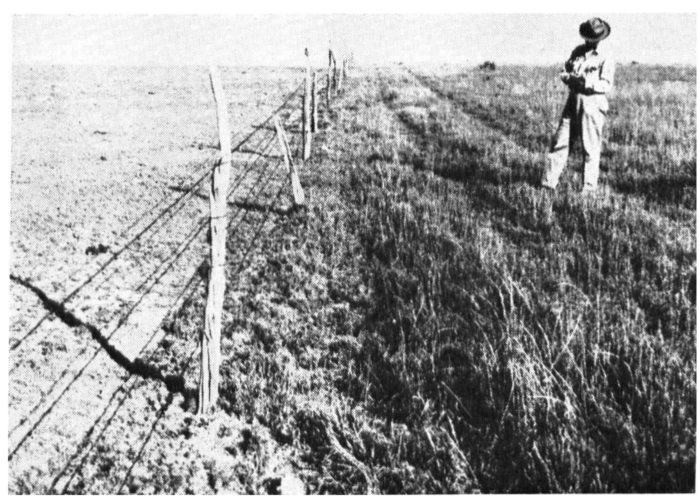


Figure 16.—Areas of the Loamy Upland range site, separated by fence, show the effects of differences in management.

cessfully if they are well planned and cared for. Tillage is needed to control weeds in windbreaks. Diversion of runoff water from surrounding areas to the windbreak site will provide additional moisture for the trees. Windbreaks that are irrigated provide protection much sooner than those on dryland. On upland sites a dryland windbreak of conifers and hardwoods should remain effective for 25 to 35 years.

The soil types in Stevens County have been arranged in tree (windbreak) planting sites (Silty Upland and Sandy Upland) as shown in the list that follows. Lincoln soils and Tivoli fine sands are not suitable sites for planting trees and, therefore, are not listed. Goshen silt loam is not listed, since only a few acres of this soil occur in the county.

Silty Upland	*Sandy Upland*
Colby loam.	Dalhart fine sandy loam.
Lofton clay loam.	Dalhart loamy fine sand.
Mansic clay loam.	Manter fine sandy loam.
Richfield loam.	Richfield loamy fine sand.
Richfield silt loam.	Otero fine sandy loam.
Ulysses silt loam.	Vona loamy fine sand.
Ulysses-Colby silt loams.	

In table 5, the species that are suitable for windbreaks are given, along with the approximate growth attained in 10 years on the Silty Upland and Sandy Upland sites.

Additional information on planting trees and developing farmstead windbreaks can be obtained from a local representative of the Soil Conservation Service and from the county extension agent.

TABLE 5.—*Trees and shrubs suitable on tree (windbreak) planting sites and approximate height attained after 10 years on dryland and irrigated soils*

Suitable trees and shrubs	Silty Upland		Sandy Upland	
	Dryland	Irrigated	Dryland	Irrigated
	Feet	*Feet*	*Feet*	*Feet*
Russian-olive	12	22	13	22
Osage-orange	12	22	13	22
Tamarisk	10	20	10	15
Mulberry	15	20	17	24
Siberian elm [1]	22	32	25	35
Honeylocust	12	22	14	24
Eastern redcedar	5	9	8	11
Rocky Mountain juniper	5	9	8	11
Ponderosa pine	6	9	8	11
Skunkbush sumac	5	9	6	9

[1] Commonly known as Chinese elm.

Wildlife Management

The ring-necked pheasant, the most important kind of wildlife, provides good hunting throughout the county. If nesting cover is provided, pheasants will remain relatively abundant.

A few quail, both bobwhite and blue, occur throughout the county. The number of quail can be increased by providing cover for nesting, protecting them from predators, and strictly complying with game laws.

Prairie chickens were once abundant, and a few still survive in the sandhills. Many jackrabbits are found in all parts of the county. Cottontail rabbits are numerous around old, abandoned farmsteads and along the Cimarron River. A few prairie-dog towns occur in native postures of mid and short grasses. Badgers, ground squirrels, and skunks also inhabit the county. Occasionally, a few deer are seen along the Cimarron River. Mourning doves are usually numerous during summer and early in fall. A few migratory waterfowl stop over in the county during their seasonal migration.

More information on the development and improvement of areas for wildlife can be obtained from a local representative of the Soil Conservation Service or the Kansas Forestry, Fish, and Game Commission.

Genesis and Morphology of the Soils

This section describes the outstanding morphological characteristics of the soils of Stevens County. The first part discusses the factors of soil formation, and the second, the classification of the soils.

Factors of Soil Formation

Soil is produced by the action of soil-forming processes on materials deposited or accumulated by geologic agencies. The characteristics of a soil at any given point are determined by (1) the physical and mineralogical composition of the parent materials; (2) the climate under which the soil material has accumulated and has existed since accumulation; (3) the plant and animal life in and on the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of development have acted on the material.[3]

Climate and vegetation are active factors of soil genesis. They act on the parent material and slowly change it into a natural body with genetically related horizons. The effects of climate and vegetation upon soil formation are conditioned by relief. The parent material also affects the kind of profile that can be formed and in extreme cases determines it almost entirely. Finally, time is needed for the changing of the parent material into a soil profile. It may be much or little, but some time is always required for horizon differentiation. The five factors of soil formation, as they relate to the soils of Stevens County, are discussed next.

Parent material

Stevens County is a part of the southern High Plains section of the Great Plains physiographic province. Most of it lies in the Cimarron Bend area of southwestern Kansas. Most of the soils have developed from sediments deposited during the Pleistocene and Recent epochs. The parent materials are mainly loess, eolian sand, and recent alluvium and also old alluvium of the Pleistocene or Late Pliocene epochs. Figure 17, a geological cross section through the center of the county, shows the broad relationship of parent materials to the soil series.

Silty windblown sediments, or loess, are the parent materials of about 50 percent of the soils in the county. This loess was deposited as a mantle over the area in the Wisconsin stage of the Pleistocene epoch, or Ice age. The mantle of loess generally ranges from about 5 to 12 feet in thickness. The loess is calcareous and pale brown. It

[3] UNITED STATES DEPARTMENT OF AGRICULTURE. SOILS AND MEN. U.S. Dept. Agr. Yearbook 1938. 1232 pp., illus. 1938.

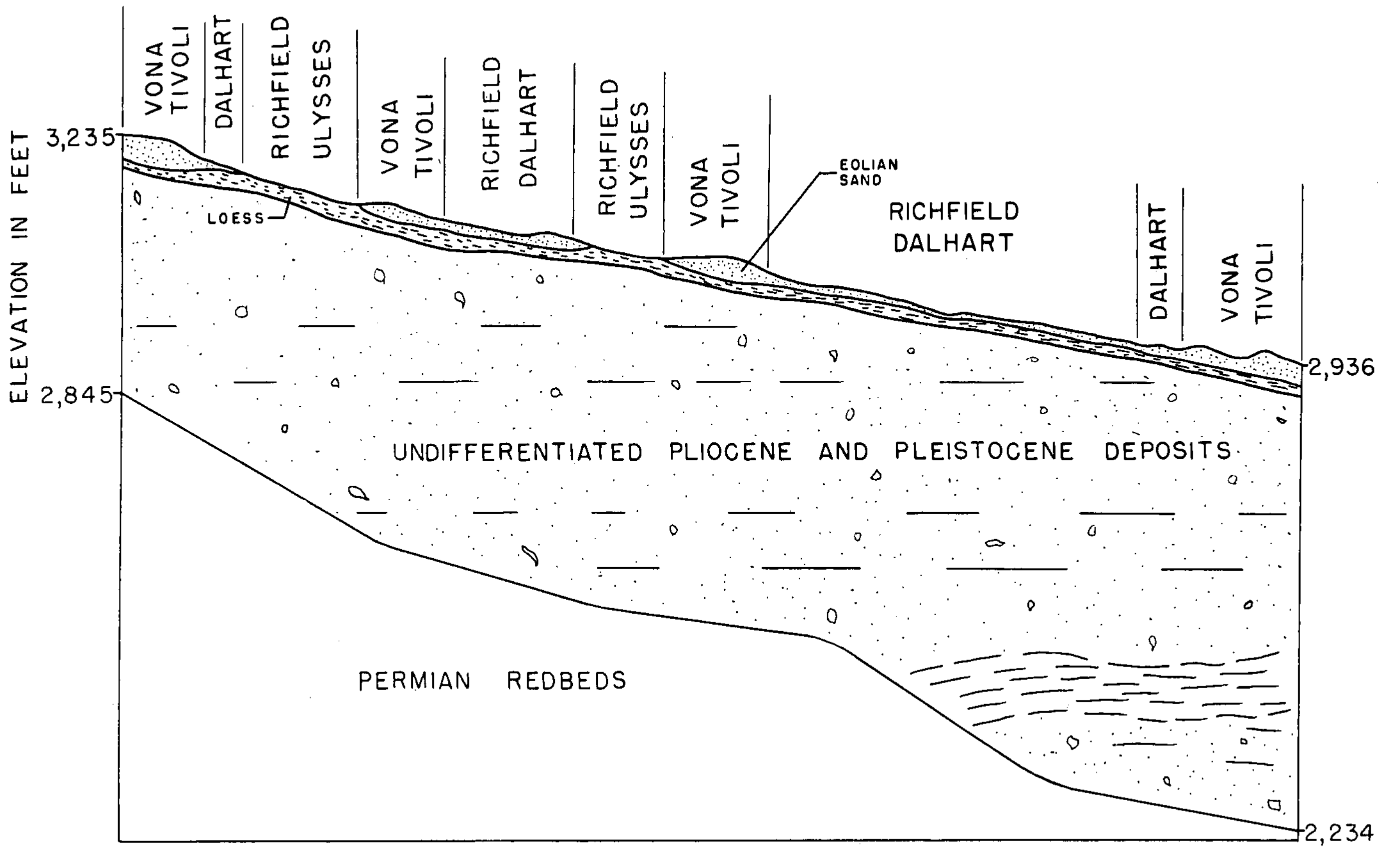


***Figure 17.*—Geological cross section through the central part of Stevens County.**

usually contains more than 50 percent silt and about 25 percent clay.

Eolian, or windblown, sands are the parent materials of about 45 percent of the soils. In most places these sands have been deposited as a mantle on the slightly older and finer textured layers of loess and outwash material. The mantle is about 5 to 30 feet thick. The deposition of these eolian sands started in the Late Pleistocene epoch and has continued intermittently until the present time. In Stevens County, areas of eolian sand make up what is known as sandhills. Where the sandhills are contiguous to the Cimarron River, the source of sand was from river deposits. Along the southern boundary of the county is another area of sandhills. These sandhills apparently consist of old alluvium reworked by the wind. They either cover or lie adjacent to the areas from which they were derived.

The remaining 5 percent of the soils were derived from recent and old alluvial deposits. The recent alluvium is sandy and gravelly material that occurs on the small flood plains of the Cimarron River. The old alluvium consists of stratified silty, clayey, and sandy sediments that occur on the sloping areas along the Cimarron River and its tributaries.

Climate

Stevens County has a semiarid climate characterized by extreme temperatures in summer and winter and deficiency of moisture in all seasons. The average annual wind velocity is fairly high. Under this type of climate, soil development proceeds somewhat more slowly than in other areas where rainfall is abundant.

Plant and animal life

The original vegetation consisted primarily of grasses, and grasses are still dominant. Trees occur only along the Cimarron River, and most stands are thin. Tall grasses, such as sand bluestem, predominate on the sandy soils. Mid and short grasses predominate in the loamy and silty soils. Over a period of many centuries, the accumulated remains of grass roots and leaves have produced the dark color of the surface layers of most of these soils.

The animals that have the most effect on soil development are worms and burrowing species. The activity of these animals in the soil has improved aeration, mixed soil from different horizons, and aided the decomposition of plant materials. Grazing by wild animals also influences soil formation both physically and chemically.

Relief

Stevens County has two main kinds of relief. The soils developed from loess occur on a large plain that is more or less smooth and has broad, gentle swells or hills and shallow depressions. The soils developed from eolian sands occur on dune-type relief. The sand dunes have been modified by time and range from young to mature. The young dunes are steep; they are 20 feet or more in height and form hilly topography. The mature dunes have been subdued by the wind; these low-lying dunes form undulating topography.

Time

Time is necessary for the development of soils from parent materials. The time required for soil formation, however, depends on the other factors of soil formation and varies a great deal from place to place. The soils of Stevens County range from very young to mature. The Tivoli soils, for example, are very young, and the Richfield soils are mature.

Classification of the Soils

Classification makes it easier to study and remember the characteristics of soils and to interpret their interrelationships. The classification units commonly used in the field are the series, type, and phase. These are discussed in the introduction to the section "Descriptions of the Soils."

Soil series may also be grouped in higher categories called great soil groups; and for some purposes, it is useful to group the great soil groups, in turn, into still higher categories called soil orders. The soils of Stevens County are classified into 12 soil series. These soil series are further classified in four great soil groups. At the highest level of soil classification, the four great soil groups are placed in one or the other of two soil orders. In table 6 the soil series are classified by higher categories, and the parent material and relief are shown for each series.

TABLE 6.—*Soil series classified by soil orders and great soil groups, and parent material and relief of the soils*

ZONAL ORDER

Great soil group and series	Parent material	Relief
Chestnut soils:		
Dalhart	Eolian sand	Undulating upland.
Goshen	Alluvium	Nearly level flood plains that are rarely inundated.
Lofton	Loess	Shallow depressions of the upland.
Mansic (intergrading toward Regosols).	Loess	Nearly level to gently sloping upland.
Manter	Eolian sand	Gently sloping upland.
Richfield	Loess	Nearly level upland.
Ulysses (intergrading toward Regosols).	Loess	Nearly level to gently sloping upland.
Brown soils:		
Vona	Eolian sand	Rolling upland.

AZONAL ORDER

Great soil group and series	Parent material	Relief
Regosols:		
Colby	Loess and old alluvium.	Moderately steep upland.
Otero	Old alluvium	Moderately steep upland.
Tivoli	Eolian sand	Hilly upland.
Alluvial soils:		
Lincoln	Sandy and gravelly alluvium.	Undulating flood plains.

Soils of the zonal order have well-expressed genetic horizons. Profiles of these soils reflect primarily the effects of climatic and biological factors on well-drained parent materials for a period of time adequate for full soil development. Zonal soils are sometimes called normal soils, or mature soils.

Azonal soils are young, or immature, soils that have few or no genetic morphological characteristics. They generally lack evidence of horizon differentiation, and their characteristics are similar to those of their parent materials. They may, however, have a slight darkening of color at the surface because of an incipient accumulation of plant material.

The zonal great soil groups in the county are Chestnut soils and Brown soils. The azonal great soil groups in the county are Regosols and Alluvial soils.

Stevens County lies in the south-central part of the Chestnut soil zone. The Chestnut soils in the county are represented by the Richfield, Ulysses, Mansic, Lofton, Manter, Goshen, and Dalhart series. The Mansic and Ulysses series have some characteristics of the Regosol great soil group and are therefore classified as intergrades between Chestnut soils and Regosols. Chestnut soils are dark brown at the surface, and they grade to a whitish calcareous horizon at depths ranging from 1 to 3 feet. They are fertile and easily tilled. Their native vegetation was mid and short grasses.

In Stevens County, the Vona series are the only soils in the Brown great soil group. These soils generally have lighter colored surface layers than the Chestnut soils. In Stevens County these soils are sandy. The native vegetation was tall grasses.

Soils of the Colby, Otero, and Tivoli series are in the Regosol great soil group. These immature soils show few or no characteristics of soil development. They are pale brown or grayish brown. The Colby and Otero soils are calcareous at or near the surface. The vegetation is tall, mid, and short grasses. Many areas of these soils occur on the steeper slopes adjacent to more gently sloping areas of Chestnut soils or Brown soils.

The Alluvial great soil group is represented by the Lincoln series in this county. These immature soils have little or no profile development, but some organic matter has accumulated in the top 2 to 4 inches. They are similar to the recent alluvium of which they are composed.

Climate[4]

Stevens County, which is in southwest Kansas, has a distinctly continental climate. The semiarid climate results from its location on the High Plains in the "rain shadow" of the Rocky Mountains and west of the moisture-laden currents from the Gulf of Mexico. Since the broad, open plains offer little obstruction to the flow of cold air from the polar regions, the county has wide extremes and rapid changes of temperature.

Low precipitation predominates in this area. Few years pass without some crop damage caused by lack of soil moisture. This area is subject to temporary and prolonged climatic shifts. As a result, occasional periods with desert

[4] By A. D. ROBB, State climatologist, U.S. Weather Bureau, Topeka, Kans.

climate alternate with periods that have precipitation typical of central Kansas.

Data on precipitation in Stevens County were taken from records of the U.S. Weather Bureau Station at Hugoton for the period 1904 through 1958. As data on temperature are incomplete at Hugoton, this information was taken from records at the station in Liberal, Seward County, for the period 1907 to 1959.

There is considerable variation in daily, seasonal, and annual temperature; this is typical of the High Plains, where there is much sunshine but cool nights. The range in temperature is 132° F., from a high of 113° (recorded on June 30, 1933 and July 1, 1933) to a low of −19° (recorded on Jan. 7, 1912). The range between the highest and lowest temperatures is greater during winter than during summer; the range in January is 104°, and that in July is only 65°.

Over a 52-year period, no summer has escaped a maximum temperature of 100° or higher. Temperatures of 110° occurred twice in 1933, twice in 1936, and on two other occasions. Figure 18 shows that temperatures of more than 100° have occurred as early as May 8 (1916) and as late as September 23 (1926). Approximately half the years of record have had 20 or more days with readings of 100° or higher. In 1934 there were 49 days and in 1936, 48 days with temperatures of 100° or higher.

In spring, a temperature of 32° or lower was recorded as late as May 27 (1907) and as early as March 25 (1943). The earliest freezing temperature in fall occurred on September 20 (1942), and the latest, on November 14 (1937). The average freeze-free period is 182 days, extending from about April 22 to October 21.[5]

Temperatures of 0° or below have occurred as early as December 4 (1909) and as late as March 12 (1948). The temperature dropped to 0°, or lower, in 40 of the 52 years of record. However, from 1951 through 1955, the temperature remained above 0°. There were 12 days in 1912 and 11 days in 1911 and 1924 with temperatures of 0°, or below.

In this area, precipitation is uncertain and irregular. On the average, the amount of precipitation increases from about half an inch in each of the winter months to about five times that amount from May through August. The least amount of annual precipitation was 7.49 inches in 1956, and the greatest was 32.15 inches in 1946. Figure 19 shows that the annual precipitation has been above average in one period of 5 successive years and in three periods of 3 successive years. On the other hand, annual precipitation has been below average in three periods of 2 successive years and in three periods of 4 successive years.

Precipitation that occurs during the summer is most important. Approximately three-fourths of the yearly precipitation falls from March through August, the period when it is needed most for summer row crops, for pasture, and for the storage of soil moisture for fall-seeded grain. In summer the amount of rainfall varies considerably. For example, in 6 years of the 55-year record, the rainfall in summer has been less than half of that of the preceding summer. Total rainfall in summer has ranged from 5.52 inches in 1952 to 23.11 inches in 1951. About one-fourth of the summers had less than 10 inches of precipitation, and about one-fourth had 15 inches or more.

Winter precipitation exceeded that of summer only in 1913 and 1946. In the summer of 1913, there was only 7.96 inches of rainfall; this was 4.90 inches below average. Heavy precipitation occurred in September, November, and December of that year to bring the annual total to 0.16 inch above average. In 1946, the period March

[5] BARK, L. DEAN. WHEN TO EXPECT LATE-SPRING AND EARLY-FALL FREEZES IN KANSAS. Kans. St. Univ. Agr. Expt. Sta. Bul. 415, 22 pp., illus. 1959.

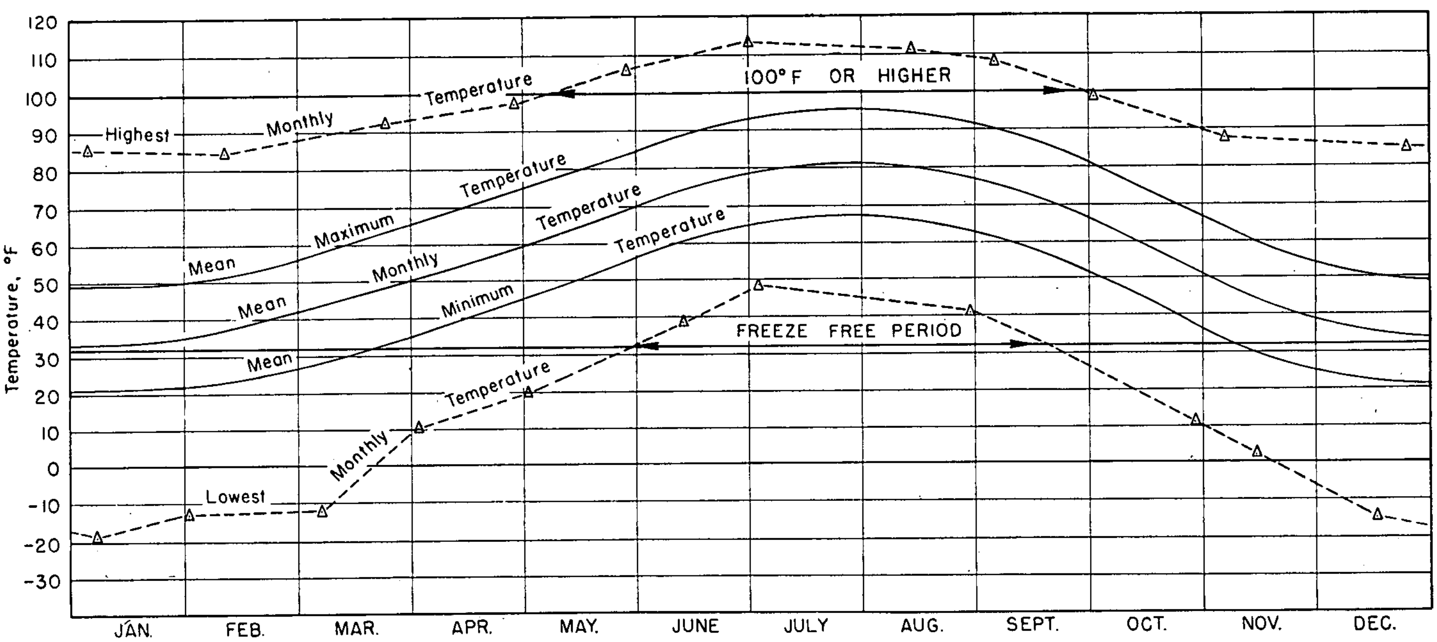


Figure 18.—**Means (averages) and extremes in temperature as recorded at the U.S. Weather Bureau Station, Liberal, Kans. Plotted points show approximate dates of highest and lowest monthly temperatures.**

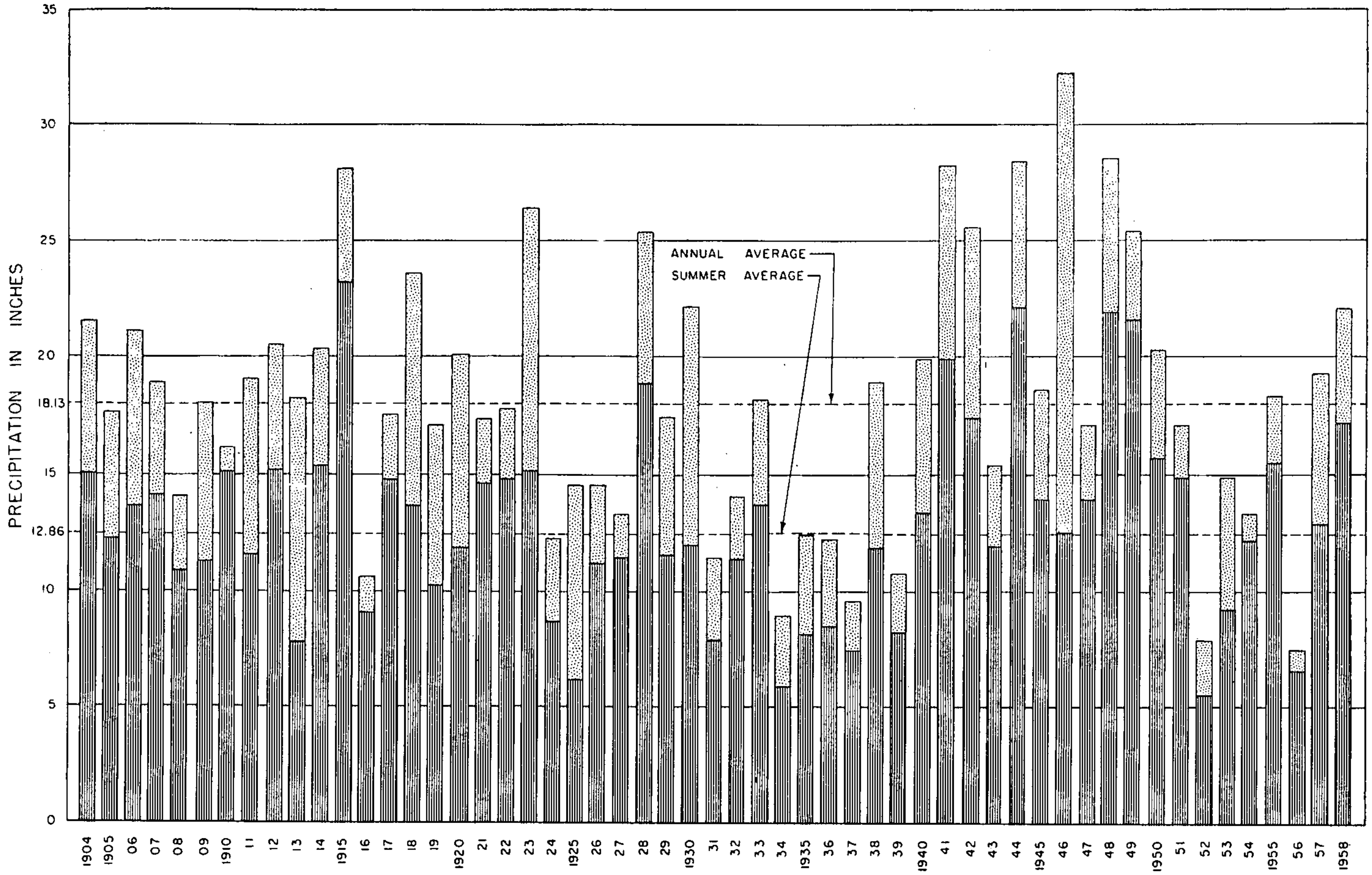


***Figure 19.*—Annual precipitation as recorded at the U.S. Weather Bureau Station, Hugoton, Kans. The shaded, or lower, part of each bar shows the amount of summer precipitation (March through August).**

through August received 12.56 inches of precipitation; this was only 0.30 inch less than average. A total of 17.59 inches of precipitation occurred from September through November, boosting the yearly total to 32.15 inches—almost double the average.

Average monthly precipitation is shown in figure 20. The months May through August have received a measurable amount of precipitation in every year of record. The other 8 months, however, have had in many years either no precipitation or only a trace. From April through October, the greatest monthly precipitation has ranged from 5 inches to slightly more than 8 inches. May has the heaviest rainfall and has received more than 5 inches in one-fifth of the years recorded. In 8 years, July has had 5 inches or more.

The seasonal snowfall varies greatly. In 12 seasons there have been 20 inches or more of snowfall, but in 7 seasons there have been less than 5 inches. In 1911–12, the total snowfall was 67.8 inches; each month from September through March received 5 or more inches of snowfall. The least amount of snowfall was 1.5 inches during 1922–23; only 0.5 inch was recorded in February and 1 inch in March. The greatest monthly snowfall was 21.5 inches in March of 1948. Because of drifting, the snow is of limited value for crops.

Prevailing winds, generally from the south, occur in this area. The untiring breeze, together with low humidity, make the summer heat much less oppressive. The cold of winter, however, is more penetrating because of the wind.

Clear days predominate in Stevens County. The sun shines approximately 70 percent of the time it is above the horizon.

Some thunderstorms in summer are severe, and damage may result from winds, tornadoes, hail, and heavy rain. Marble-sized hailstone, driven by strong winds, probably have caused the most damage to crops. In winter, strong winds and blinding snow, although rare, are hazards. Glaze and sleet storms occasionally develop, severely damage power and transmission lines, and are a hazard to motor traffic for short periods.

Agriculture

The agriculture of Stevens County is based on the production of grain sorghum and wheat as cash crops. This county is one of the leading producers of grain sorghum in the State.

Cattle raising was the main type of agriculture before 1916. At that time a small acreage of sandy soils was

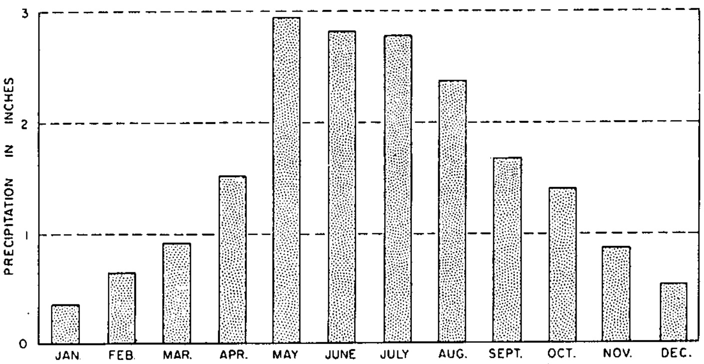


Figure 20.—**Average monthly precipitation as recorded at the U.S. Weather Bureau Station, Hugoton, Kans.**

being cultivated to provide grain and forage for cattle. From 1916 to 1958, the acreage in cropland increased from about 12 percent of the county to about 85 percent. Much of this increase occurred in the 1920's. The year 1919 was the first in which a large acreage of wheat was sown.

Farming operations are on a large scale and are highly mechanized. About 34,000 acres are being irrigated. Wheat and sorghum are the principal irrigated crops.

Unless otherwise specified, statistics in this section are taken from the biennial reports of the Kansas State Board of Agriculture.

Crops

Wheat and grain sorghum, the major crops grown, are best suited to dryland agriculture and the climate of Stevens County. On the silty and loamy soils, these crops are usually grown in a crop-fallow system. During the fallow period, weeds are controlled so that moisture is conserved for use by the following crop. Grain and forage sorghums are grown continuously on the sandy soils. A small acreage of broomcorn also is grown on the sandy soils.

Table 7 gives the acreage of the main crops grown in Stevens County in stated years.

TABLE 7.—*Acreage of principal crops in stated years*

Crop	1925	1930	1940	1950	1957
Wheat	92, 473	[1]61, 033	61, 000	127, 000	21, 000
Sorghum:					
Grain	[1]69, 174	[1]44, 273	108, 490	134, 150	253, 000
Forage	[1]13, 033	[1]10, 027	26, 250	[1]12, 830	[1]4, 000
Corn	[1]11, 436	[1]17, 901	1, 500	60	300
Barley	[1]6, 346	[1]4, 035	13, 260	2, 100	2, 900
Broomcorn	[1]6, 745	[1]19, 365	[1]10, 730	[1]490	[1]940
Hay	[1]1, 345	[1]1, 838	[1]8, 860	[1]1, 360	[1]1, 570

[1] Acres harvested (acre planted not reported).

Pasture

In 1958, there were about 72,000 acres of pasture or rangeland in Stevens County. Most of it occurs on sandhills or in sandy areas. Sagebrush and annual weeds are the dominant plants on most areas. If managed properly, the range will produce native tall and mid grasses. A small acreage of loamy soils is used for pasture. The loamy soils will support native mid and short grasses.

Livestock

Cattle are the principal livestock in the county. The number of beef cattle varies according to the local supply of feed. Only a few cattle are raised in the county. In fall and winter, however, many cattle are brought in to graze wheat pasture and sorghum stubble. Most of the beef cattle are of good quality. The number of dairy cattle has been consistently low in recent years. Most of the dairy cattle are in herds, but a few farmers keep a milk cow.

Horses and mules have gradually decreased in number as tractors have been improved and made available. Most of the horses are now used for riding. Small flocks of poultry are kept on a few farms. A few farmers raise swine, which are generally of good quality. Not many sheep are raised in the county, but many sheep may be brought in during fall and winter to graze wheat pasture and sorghum stubble.

Table 8 lists the number of livestock on farms and ranches of Stevens County in stated years.

TABLE 8.—*Number of livestock on farms and ranches in stated years*

Livestock	1925	1930	1940	1950	1957
All cattle	7, 536	5, 720	4, 580	6, 800	5, 500
Horses and mules	7, 995	4, 261	600	490	280
Swine	2, 419	1, 552	3, 140	2, 050	800
Sheep and lambs	3	290	280	19, 810	110
Chickens (over 3 months old)	([1])	([1])	40, 610	26, 600	11, 000

[1] Not reported.

Size, Type, and Tenure of Farms

Stevens County had a total of 634 farms in 1930, according to the Federal census. Since that time, farms have decreased in number and increased in size. By 1957, there were only 395 farms in the county. Most of these, however, were large and highly mechanized. The number of farms in various size groups was as follows, according to the 1954 Federal census:

Size of farms in acres	*Number*
Under 99	19
100 to 219	25
220 to 499	80
500 to 999	156
1,000 and over	156

The 1954 census shows that 275 farmers resided on the farms they operated. The rest of the farmers lived in towns and in other counties.

Most of the farms are of the cash-grain type. The 1954 Federal census shows that about 2 percent of the farms are miscellaneous and unclassified. The rest of the farms are classified by type as follows:

	Number
Cash grain	404
Poultry	5
Livestock	17

A few farms consist entirely of irrigated land.

A relatively few farmers own all the land they operate. It is common for a farmer to rent land from two or more owners. The land is usually leased on a crop-share basis; the owner gets from one-fourth to one-third of the crop. About 65 percent of the land in the county is owned by nonoperators. The tenure on farms, as shown by the 1954 Federal census, is as follows:

Type of tenure	*Number*
Full owners	50
Part owners	191
All tenants	195
Cash	4
Share-cash	11
Crop-share	161
Livestock-share	9
Other	10

Farm Equipment and Labor

All tillage and harvesting are done with mechanically powered equipment. Generally the industrial type wheel tractor is used. Large, self-propelled combines harvest the wheat and grain sorghum. Most farmers own enough equipment for tillage and planting, but some of them must hire part or all of the machinery for harvesting. Custom operators from outside the area commonly furnish much of the labor and equipment necessary for harvesting grain crops.

The demand for labor is seasonal. The local labor supply is about adequate for planting and tillage operations, but transient labor is generally needed during the harvest. Only a few farmers have hired help the year round. A total of 87 farm operators worked 100 days or more at jobs outside their farms, according to the 1954 Federal census.

General Nature of the County

Some of the general characteristics of the county are discussed in this section. These are physiography, relief, and drainage; history and population; water supply; industries; transportation and markets; and community facilities.

Physiography, Relief, and Drainage

Stevens County is a part of the southern High Plains section of the Great Plains physiographic province. About 95 percent of the county consists of upland plains and sandhills, and the rest is stream flood plains and intermediate slopes. Large areas on the upland are comparatively flat and featureless. In detail, however, most parts of these areas are more or less smooth and consist of broad, gentle swells or hills and shallow depressions. The sandhills have hilly or rolling topography. They consist of dunes of sand that differ in age and size. The larger dunes are 20 feet or more high. Figure 2 in the section "General Soil Areas" illustrates the landscape of the county.

The elevation of the upland ranges from about 3,283 feet above sea level in the southwestern part of the county to 2,936 feet on the eastern county line. The lowest point in the county is in the northeastern corner. The general slope is in an east-southeast direction at about 11 feet per mile. On the average the Cimarron River is a little over a hundred feet below the adjacent upland.

The Cimarron River passes through the northwestern part of the county. It is an intermittent stream in this county and flows only after there is intensive rainfall upstream. The flood plain is small and is only a few feet higher than the riverbed. Sandhills occur on the southern and eastern sides of the Cimarron River, and a sloping valley wall, consisting of less sandy materials, occurs on the western side.

The Cimarron River and its tributaries drain about 10 percent of the area; the rest has no exterior drainage. Rain that falls on the flat upland and sandhills drains into temporary ponds or small, shallow lakes, where it evaporates or percolates downward in the soil. Stream dissection in this county is in the stage known as topographic youth.

History and Population

Before 1870, the area that is now Stevens County was inhabited chiefly by Indians. After 1886, farmers started settling in this area. Most of the early settlers were cattlemen. In the early days, the Santa Fe Trail crossed the northwestern corner of the county. A railroad was constructed across the county in 1912.

An unorganized county of Stevens was formed in 1873. It was named after Thaddeus Stevens, an American statesman. In 1883, it became a part of Seward County when the western boundary of Seward County was extended to the Colorado-Kansas State line.

Stevens County was organized on August 3, 1886. In the same year, Hugoton was made the county seat.

The county had a population of 4,413 in 1957. In that year the population of Hugoton was 2,871, and that of Moscow was 212.

Water Supply

Stevens County obtains its water from wells drilled into the huge reservoir of ground water. In the upland the depth to the water table ranges from about 75 to 215 feet. The water-bearing material ranges in thickness from about 175 to 600 feet. Wells drilled any place in the county supply enough water for domestic use and for livestock. Irrigation wells are not so easy to locate because they must be drilled into porous material that will furnish large amounts of water. Test holes have to be drilled to locate favorable strata of gravel or sand. In 1958, there were 114 irrigation wells in the county. The water is hard but is suitable for most uses.

Industries

The only important nonagricultural industry in the county is the production, collection, and transportation of natural gas. There are 32 gas-producing companies in Stevens County. About 25 percent of the working population is employed by the natural gas industry.

Natural gas occurs in an almost continuous zone that generally ranges from 2,500 to 3,000 feet below the surface. In general, the gas wells are highly productive, although the gas pressure is less than it was when the first wells were drilled.

578561—61——3

Transportation and Markets

There are improved roads throughout the county, except in some areas of the sandhills. U.S. Highway No. 270 enters the county from the east. It turns north at Hugoton and goes to Ulysses in Grant County. U.S. Highway No. 56 enters at the northeastern corner of the county, passes through Moscow and Hugoton, and goes southwest to Rolla and Elkhart in Morton County. A branch line of the Santa Fe railroad furnishes transportation.

Most of the farm products, chiefly wheat and grain sorghum, are marketed locally. Hugoton, Moscow, Coopervi1le, and Feterita have facilities for handling and storing grain; the grain is shipped by railroad to the terminal elevators and markets to the east. Beef cattle are shipped to markets outside the county. Many farmers in the southeastern part of the county sell their farm products in adjoining counties.

Community Facilities

There are seven elementary schools in the county, five of which are in rural areas. High schools are located in Hugoton and Moscow.

A hospital in Hugoton is well equipped to handle the medical needs of the county. There are 15 churches of various denominations; two of these are in rural areas.

Most of the farm dwellings are well kept. All have natural gas, and most of them have electricity. All parts of the county have mail service.

Glossary

Alluvial soils. Soils developing from transported and relatively recently deposited material (alluvium) with little or no modification of the original materials by soil-forming processes. (Soils with well-developed profiles that have formed from alluvium are grouped with other soils having the same kind of profiles, not with the alluvial soils.)

Association, soil. A pattern of different soils selected to be one of the units on a soil map, or a geographic grouping useful for describing the soils of an area.

Azonal soils. A general group of soils having little or no soil profile development. Most of these soils are young.

Calcareous soil. A soil containing enough calcium carbonate to effervesce (fizz) when treated with dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter (0.000079 inch) in diameter. As a soil textural class, soil material that contains 40 percent or more of clay, less than 45 percent of sand, and less than 40 percent of silt.

Clayey soils. As used in this report, soils that contain more than 30 percent of clay.

Consistence, soil. The nature of soil material that is expressed by the resistance of the individual particles to separating from one another (cohesion) or by the ability of a soil mass to undergo a change in shape without breaking (plasticity). The consistence varies with the moisture content. Thus, a soil aggregate or clod may be hard when dry and plastic when wet. Terms used to describe consistence are—

Very friable. When moist, soil material crushes under very gentle pressure but coheres when pressed together.

Friable. When moist, soil material crushes easily under gentle to moderate pressure between thumb and forefinger and coheres when pressed together.

Firm. When moist, soil material crushes under moderate pressure between thumb and forefinger but resistance is distinctly noticeable.

Loose. When moist or dry, soil material is noncoherent.

Soft. When dry, soil material is very weakly coherent; breaks to powder or individual grains under very slight pressure.

Slightly hard. When dry, soil material is weakly resistant to pressure; easily broken between thumb and forefinger.

Hard. When dry, soil material is moderately resistant to pressure; can be broken in the hands without difficulty but is barely breakable between the thumb and forefinger.

Very hard. When dry, soil material is very resistant to pressure; can be broken in the hands only with difficulty; not breakable between thumb and forefinger.

Flood plain. The nearly flat surface subject to overflow along stream courses.

Genesis. Mode of origin of the soil, referring particularly to the processes responsible for the development of the solum (horizons A and B) from the unconsolidated parent material.

Great soil group. A broad group of soils having common internal soil characteristics.

Horizon, soil. A layer of soil, approximately parallel to the land surface, with relatively well-defined characteristics that have been produced by the soil-building processes.

Horizon A. The surface horizon of a mineral soil having maximum biological activity, or eluviation (removal of materials dissolved or suspended in water), or both.

Horizon B. A soil horizon, usually beneath an A horizon, or surface soil, in which (1) clay, iron, or aluminum, with accessory organic matter, have accumulated by receiving suspended material from the A horizon above it or by clay development in place; (2) the soil has a blocky or prismatic structure; or (3) the soil has some combination of these features. In soils with distinct profiles, the B horizon is roughly equivalent to the general term "subsoil."

Horizon C. The layer of partly weathered material underlying the B horizon; the substratum; usually part of the parent material.

Loamy soil. As used in this report, soil that contains less than 45 percent of silt, 40 to 55 percent of sand, and 10 to 27 percent of clay.

Loess. Geological deposit of relatively uniform fine material, mostly silt, presumably transported by wind. Many unlike kinds of soil in the United States have developed from loess blown out of alluvial valleys and from other deposits during periods of aridity.

Massive. Uniform masses of cohesive soil, with ill-defined and irregular cleavage; structureless.

Morphology, soil. The physical constitution of the soil expressed in the kinds of horizons, the thickness of horizons, the profile arrangement, and the texture, structure, consistence, porosity, and color of each horizon.

Normal soil. A soil having a profile in equilibrium with two principal forces of the environment—native vegetation and climate—usually developed on upland, with good drainage, from any parent material, not of extreme texture or chemical composition, that has been in place long enough for biological forces to exert their full effect.

Parent material. The unconsolidated mass from which the soil profile develops.

Permeability, soil. The quality of a soil horizon that enables water or air to move through it. It can be measured quantitatively in terms of rate of flow of water through a unit cross section in unit time under specified temperature and hydraulic conditions. Values for saturated soils usually are called hydraulic conductivity. The permeability of a soil may be limited by the presence of one nearly impermeable horizon, even though the others are permeable.

Phase, soil. The subdivision of a soil type having variations in characteristics not significant to the classification of the soil in its natural landscape but significant to the use and management of the soil. Examples of the variations recognized by phases of the soil types include differences in slope, stoniness, and erosion.

Profile, soil. A vertical section of the soil extending from the surface into the parent material.

Relief. The elevation or inequalities of a land surface considered collectively.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 millimeter (0.002 inch) to 2.0 millimeters (0.079 inch). Usually sand grains consist chiefly of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more of sand and not more than 10 percent of clay.

Sandy soil. As used in this report, a soil that contains more than 55 percent of sand and less than 20 percent of clay.

Series, soil. A group of soils that have soil horizons similar in their differentiating characteristics and arrangement in the soil profile, except for the texture of the surface soil, and formed from a particular type of parent material. The soil series is an important category in detailed soil classification. Individual series are given proper names from place names near their first recorded occurrence.

Silt. Small mineral soil grains ranging from 0.05 millimeter (0.002 inch) to 0.002 millimeter (0.000079 inch) in diameter. Soils of the textural class silt contain 80 percent or more of silt and less than 12 percent of clay.

Slope. The incline of the land surface. It is usually expressed in percentage of slope, which equals the number of feet of fall per 100 feet of horizontal distance. The slope classes used in this report are as follows:

- 0 to 1 percent:
  - Nearly level.
- 1 to 3 percent:
  - Single slopes—gently sloping.
  - Complex slopes—undulating.
- 3 to 5 percent:
  - Single slopes—sloping.
  - Complex slopes—rolling.
- 5 to 12 percent:
  - Single slopes—moderately steep.
  - Complex slopes—hilly.

Soil. A natural body on the surface of the earth, characterized by conformable layers that result from modification of parent material by physical, chemical, and biological forces through various periods of time.

Soil separates. The individual size groups of soil particles, as sand, silt, and clay.

Soil textural class. A classification based on the relative proportion of soil separates. The principal classes, in increasing order of the content of the finer separates, are as follows: Sand, loamy sand, sandy loam, loam, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay.

Structure, soil. The natural arrangement or aggregation of primary soil particles into compound particles, or aggregates. Soil structure is classified according to grade, class, and type.

Grade. Distinctness of aggregation. Grade expresses the differential between cohesion within aggregates and adhesion between aggregates. Terms: Structureless (single grain or massive), weak, moderate, and strong.

Class. Size of soil aggregates. Term: Very fine or very thin, fine or thin, medium, coarse or thick, and very coarse or very thick.

Type. Shapes of soil aggregates. Terms: Platy, prismatic, columnar, blocky, subangular blocky, granular, and crumb.

Subsoil. That part of the soil profile commonly below plow depth and above the parent material. It may be the B horizon in soils with distinct profiles.

Substratum. Any layer lying beneath the solum or true soil. A term applied to the parent material, or to other layers unlike the parent material that lie below the B horizon, or subsoil.

Surface soil. Technically, the A horizon; commonly, the part of the upper profile usually stirred by tillage implements.

Texture, soil. The relative proportions of the various size groups of individual soil grains.

Type, soil. A group of soils having genetic horizons similar as to differentiating characteristics, including texture and arrangement in the soil profile, and developed from a particular kind of parent material.

Zonal soil. Any one of the great groups of soils having well-developed soil characteristics that reflect the influence of the active factors of soil genesis—climate and living organisms, chiefly vegetation.

GUIDE TO MAPPING UNITS, CAPABILITY UNITS, AND RANGE SITES

[See table 1, p. 5, for approximate acreage and proportionate extent of the soils, and table 4, p. 21, for estimated average yields per acre on arable soils under dryland farming]

Map symbol	*Mapping unit*	Page	*Capability unit* Dryland	Page	Irrigated	Page	*Range site*	Page
Bo	Blown-out land	9	VIIe-1	18	(1)		Choppy Sands	23
Bx	Broken land	9	VIIw-1	18	(1)		(2).	
Cm	Colby loam, 5 to 12 percent slopes	6	VIe-1	18	(1)		Loamy Upland	24
Da	Dalhart fine sandy loam, 0 to 1 percent slopes	6	IIIe-3	17	I-2	19	Sandy	23
Db	Dalhart fine sandy loam, 1 to 3 percent slopes	6	IIIe-2	17	IIe-2	19	Sandy	23
Df	Dalhart loamy fine sand, 0 to 3 percent slopes	6	IVe-3	17	IIIe-4	19	Sands	23
Dx	Dalhart-Otero fine sandy loams	6	IVe-3	17	IIIe-4	19	Sandy	23
Go	Goshen silt loam	7	IIIc-2	16	I-1	19	Loamy Upland	24
Lf	Lincoln soils	7	VIIw-1	18	(1)		(2).	
Lo	Lofton clay loam	8	IVw-1	18	(1)		Loamy Upland	24
Lp	Lofton fine sandy loam	8	IVw-1	18	(1)		Sandy	23
Ma	Mansic clay loam, 0 to 1 percent slopes	8	IIIc-1	16	I-1	19	Loamy Upland	24
Mb	Mansic clay loam, 1 to 3 percent slopes	8	IIIe-1	17	IIe-1	19	Loamy Upland	24
Mx	Mansic-Otero complex	8	VIe-1	18	(1)		Loamy Upland	24
My	Manter fine sandy loam, 0 to 3 percent slopes	9	IIIe-2	17	IIe-2	19	Sandy	23
Ot	Otero fine sandy loam, 5 to 12 percent slopes	9	VIe-3	18	(1)		Sandy	23
Ra	Richfield loam, thick surface, 0 to 1 percent slopes	10	IIIc-1	16	I-1	19	Loamy Upland	24
Rb	Richfield loamy fine sand, 0 to 1 percent slopes	10	IVe-3	17	IIIe-4	19	Sands	23
Rm	Richfield silt loam, 0 to 1 percent slopes	9	IIIc-1	16	I-1	19	Loamy Upland	24
Rx	Richfield-Ulysses loams, 0 to 1 percent slopes	11	IIIc-1	16	I-1	19	Loamy Upland	24
Tf	Tivoli fine sand	11	VIIe-1	18	(1)		Choppy Sands	23
Ua	Ulysses silt loam, 0 to 1 percent slopes	11	IIIc-1	16	I-1	19	Loamy Upland	24
Ub	Ulysses silt loam, 1 to 3 percent slopes	11	IIIe-1	17	IIe-1	19	Loamy Upland	24
Uc	Ulysses silt loam, 3 to 5 percent slopes	11	IVe-2	17	(1)		Loamy Upland	24
Ue	Ulysses-Colby complex, 1 to 3 percent slopes, eroded.	12	IVe-2	17	(1)		Loamy Upland	24
Vo	Vona loamy fine sand	12	IVe-1	17	IVe-4	20	Sands	23
Vx	Vona-Tivoli loamy fine sands	12	VIe-2	18	(1)		Sands	23

[1] Considered unsuitable for irrigation.

[2] Because the soil and vegetation are unstable, this mapping unit is not considered a true range site.

Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at (800) 457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

Nondiscrimination Statement

Nondiscrimination Policy

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers, employees, and applicants for employment on the basis of race, color, national origin, age, disability, sex, gender identity, religion, reprisal, and where applicable, political beliefs, marital status, familial or parental status, sexual orientation, whether all or part of an individual's income is derived from any public assistance program, or protected genetic information. The Department prohibits discrimination in employment or in any program or activity conducted or funded by the Department. (Not all prohibited bases apply to all programs and/or employment activities.)

To File an Employment Complaint

If you wish to file an employment complaint, you must contact your agency's EEO Counselor (http://directives.sc.egov.usda.gov/33081.wba) within 45 days of the date of the alleged discriminatory act, event, or personnel action. Additional information can be found online at http://www.ascr.usda.gov/complaint_filing_file.html.

To File a Program Complaint

If you wish to file a Civil Rights program complaint of discrimination, complete the USDA Program Discrimination Complaint Form, found online at http://www.ascr.usda.gov/complaint_filing_cust.html or at any USDA office, or call (866) 632-9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter by mail to U.S. Department of Agriculture; Director, Office of Adjudication; 1400 Independence Avenue, S.W.; Washington, D.C. 20250-9419; by fax to (202) 690-7442; or by email to program.intake@usda.gov.

Persons with Disabilities

If you are deaf, are hard of hearing, or have speech disabilities and you wish to file either an EEO or program complaint, please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

If you have other disabilities and wish to file a program complaint, please see the contact information above. If you require alternative means of communication for

program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

Supplemental Nutrition Assistance Program

For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (http://directives.sc.egov.usda.gov/33085.wba).

All Other Inquiries

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferries
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings
- School
- Church
- Station

Mines and Quarries
- Mine dump
- Pits, gravel or other

Power lines

Pipe lines

Cemeteries

Dams

Levees

Tanks

Oil wells

BOUNDARIES

- National or state
- County
- Township, U. S.
- Section line, corner
- Reservation
- Land grant

DRAINAGE

Streams
- Perennial
- Intermittent, unclass.

Canals and ditches — CANAL, DITCH

Lakes and ponds
- Perennial
- Intermittent

Wells — flowing

Springs

Marsh

Wet spot

RELIEF

Escarpments
- Bedrock
- Other

Prominent peaks

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

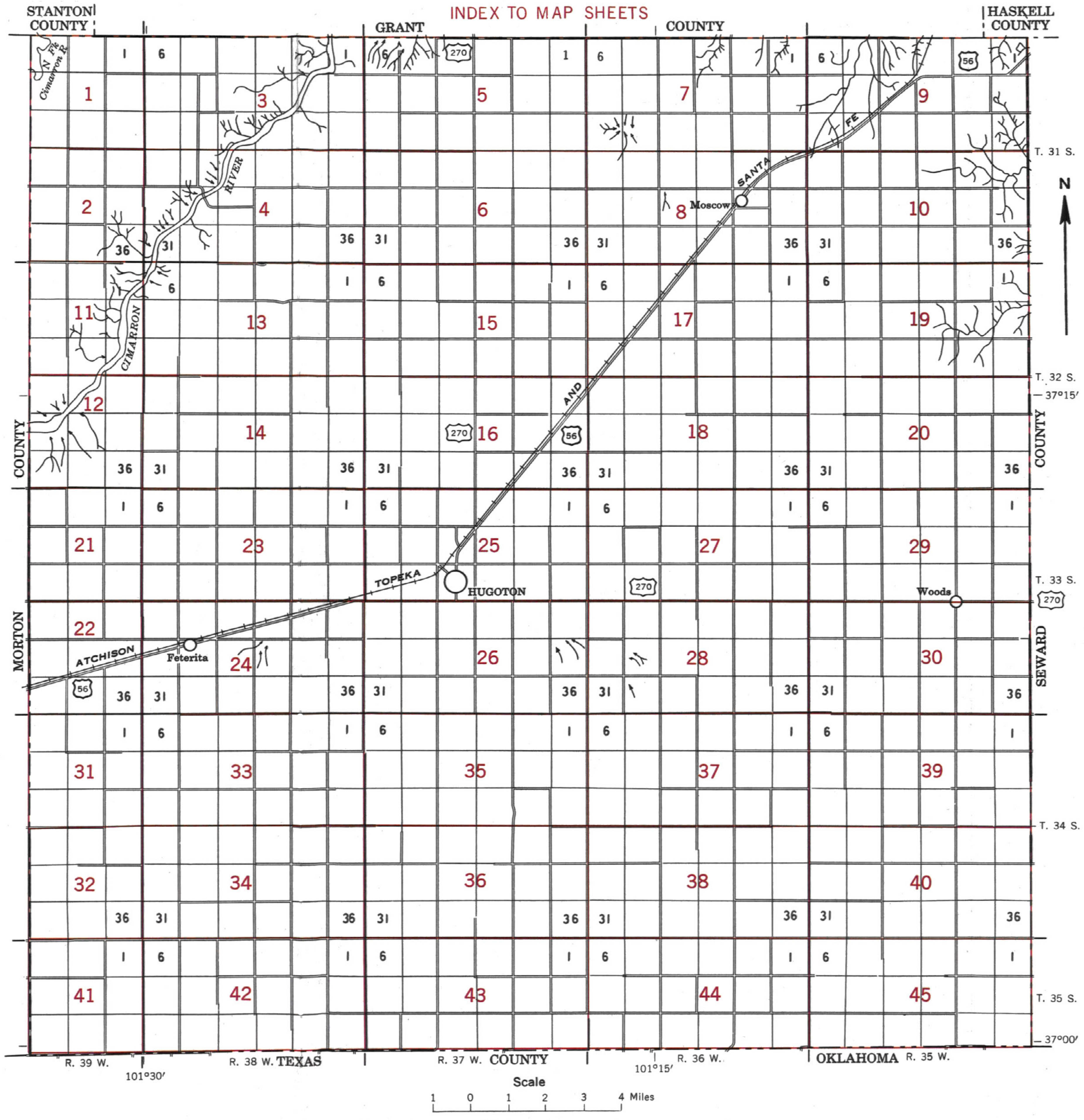
SOIL SURVEY DATA

- Soil boundary and symbol — Dx
- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gullies
- Chalky or limy spots, some eroded....

SOIL LEGEND

SYMBOL	NAME
Bo	Blown-out land
Bx	Broken land
Cm	Colby loam, 5 to 12 percent slopes
Da	Dalhart fine sandy loam, 0 to 1 percent slopes
Db	Dalhart fine sandy loam, 1 to 3 percent slopes
Df	Dalhart loamy fine sand, 0 to 3 percent slopes
Dx	Dalhart-Otero fine sandy loams
Go	Goshen silt loam
Lf	Lincoln soils
Lo	Lofton clay loam
Lp	Lofton fine sandy loam
Ma	Mansic clay loam, 0 to 1 percent slopes
Mb	Mansic clay loam, 1 to 3 percent slopes
Mx	Mansic-Otero complex
My	Manter fine sandy loam, 0 to 3 percent slopes
Ot	Otero fine sandy loam, 5 to 12 percent slopes
Ra	Richfield loam, thick surface, 0 to 1 percent slopes
Rb	Richfield loamy fine sand, 0 to 1 percent slopes
Rm	Richfield silt loam, 0 to 1 percent slopes
Rx	Richfield-Ulysses loams, 0 to 1 percent slopes
Tf	Tivoli fine sand
Ua	Ulysses silt loam, 0 to 1 percent slopes
Ub	Ulysses silt loam, 1 to 3 percent slopes
Uc	Ulysses silt loam, 3 to 5 percent slopes
Ue	Ulysses-Colby complex, 1 to 3 percent slopes, eroded
Vo	Vona loamy fine sand
Vx	Vona-Tivoli loamy fine sands

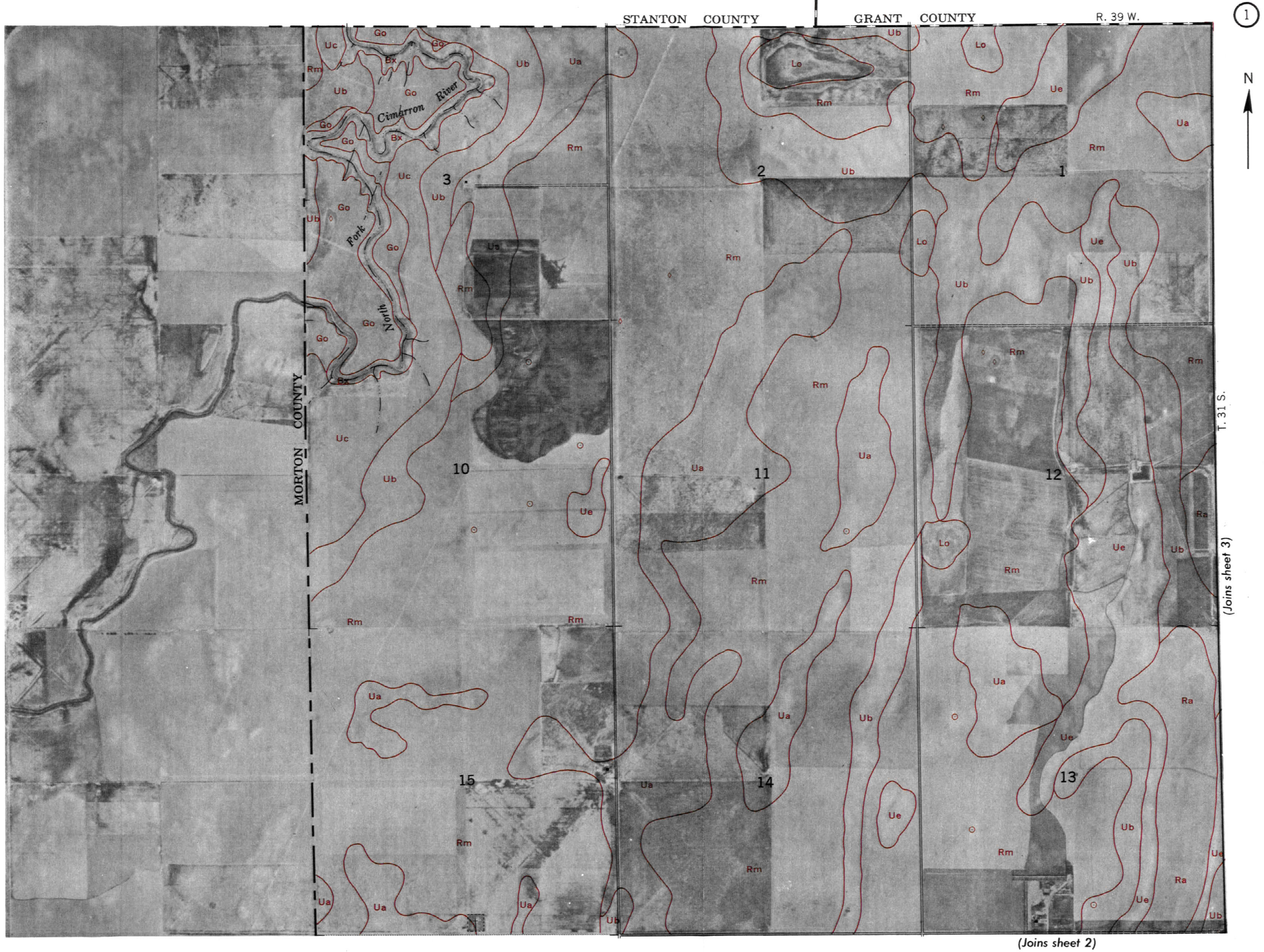
Soil map constructed 1960 by Cartographic Division, Soil Conservation Service, USDA, from 1953 aerial photographs. Controlled mosaic based on Kansas plane coordinate system, south zone, Lambert conformal conic projection, 1927 North American datum.



1

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

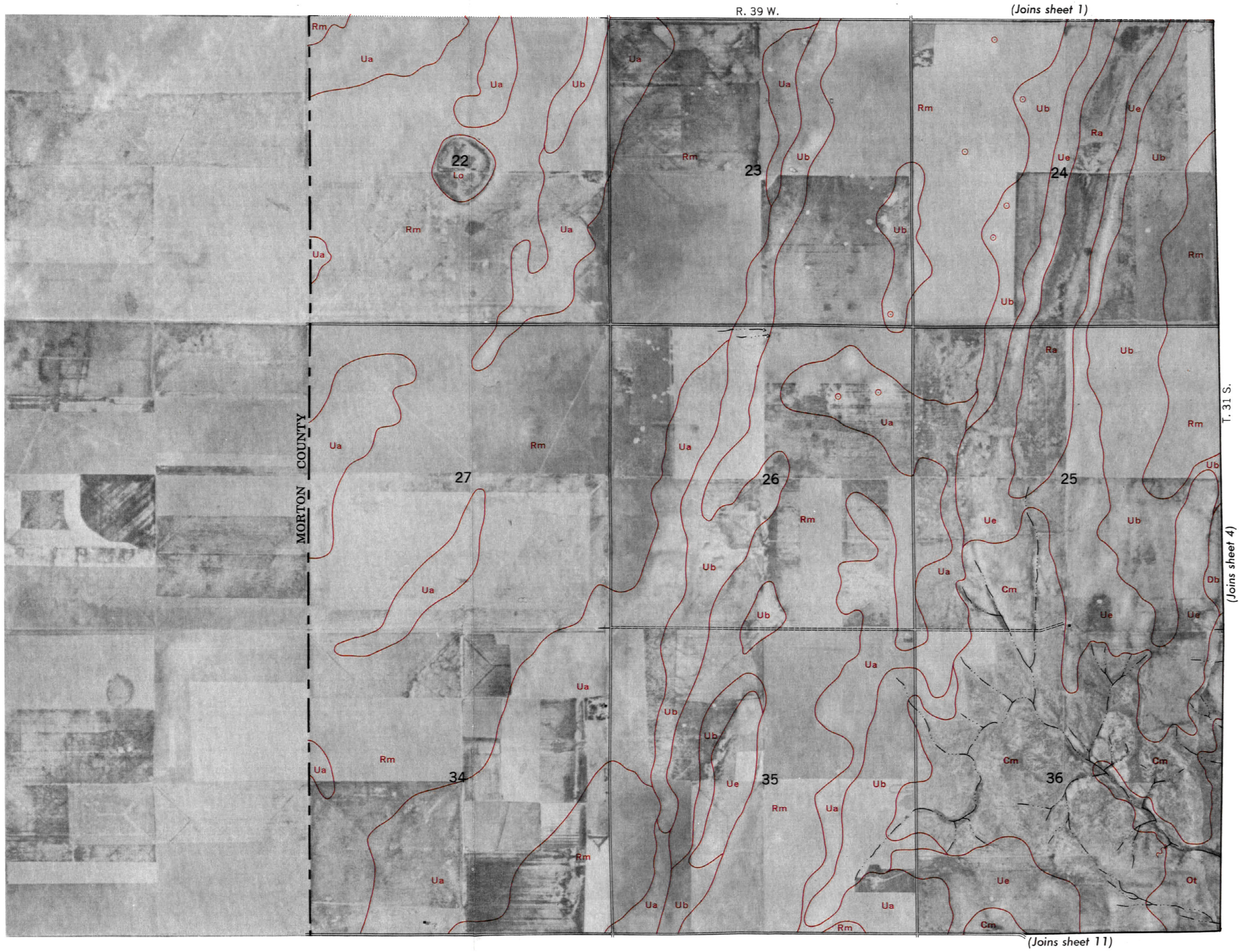
Range, township, and section corners shown on this map are indefinite.



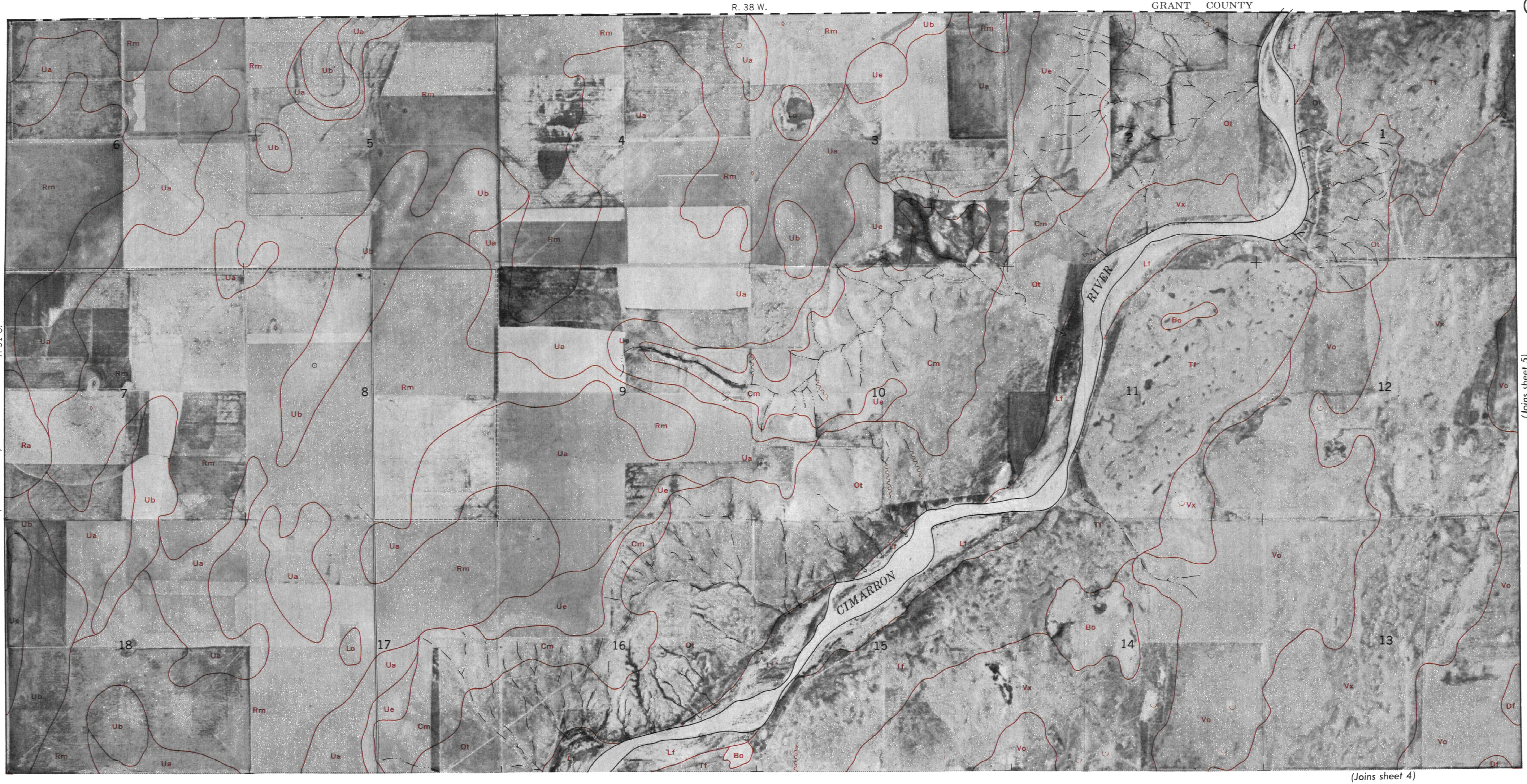
0 ½ 1 Mile Scale 1:20000 0 5000 Feet

STEVENS COUNTY, KANSAS — SHEET NUMBER 2

2



0 ½ 1 mile Scale 1:20 000 0 5000 feet

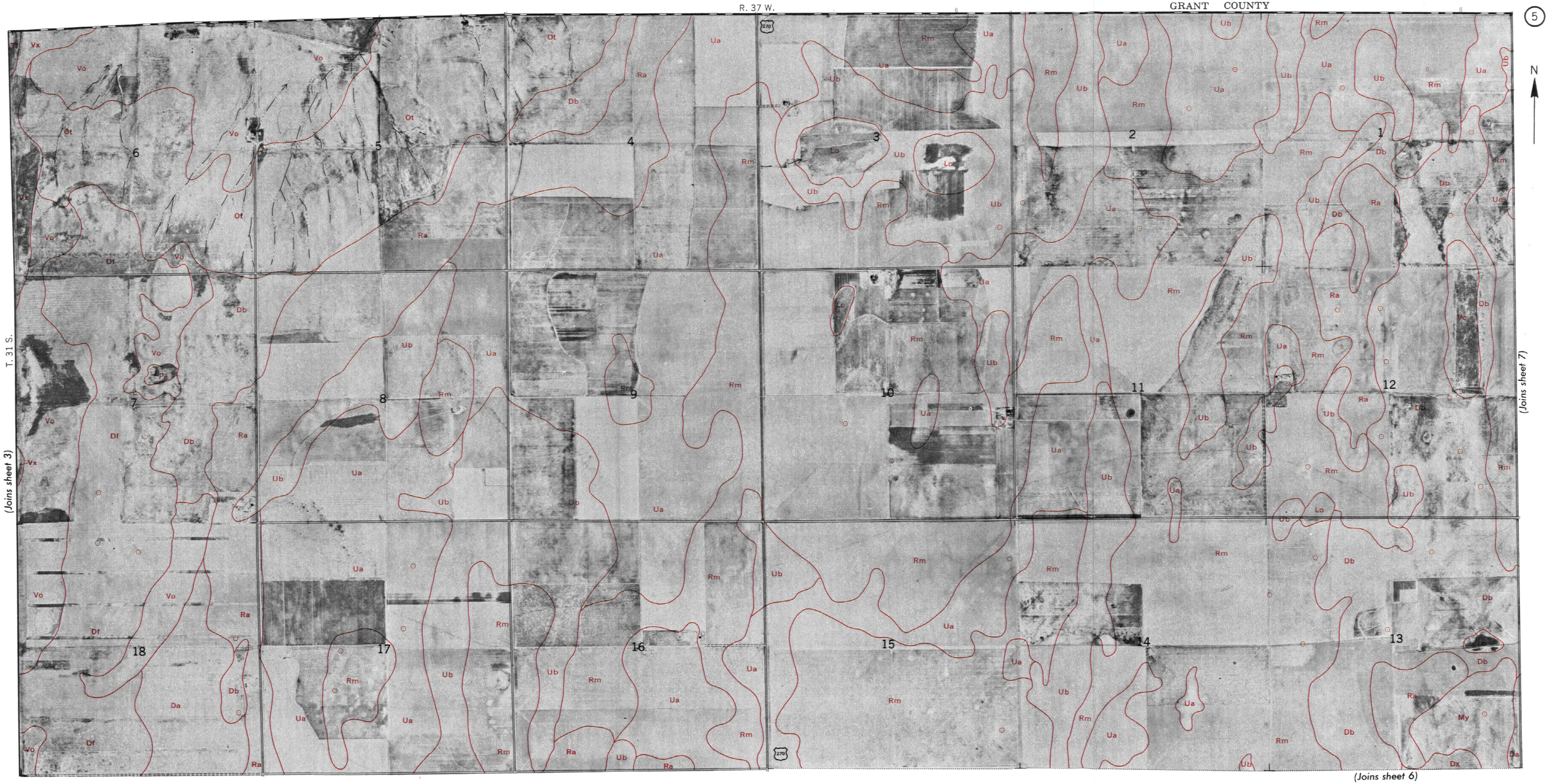


0 ½ 1 mile Scale 1:20 000 0 5000 feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.

STEVENS COUNTY, KANSAS — SHEET NUMBER 4



This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

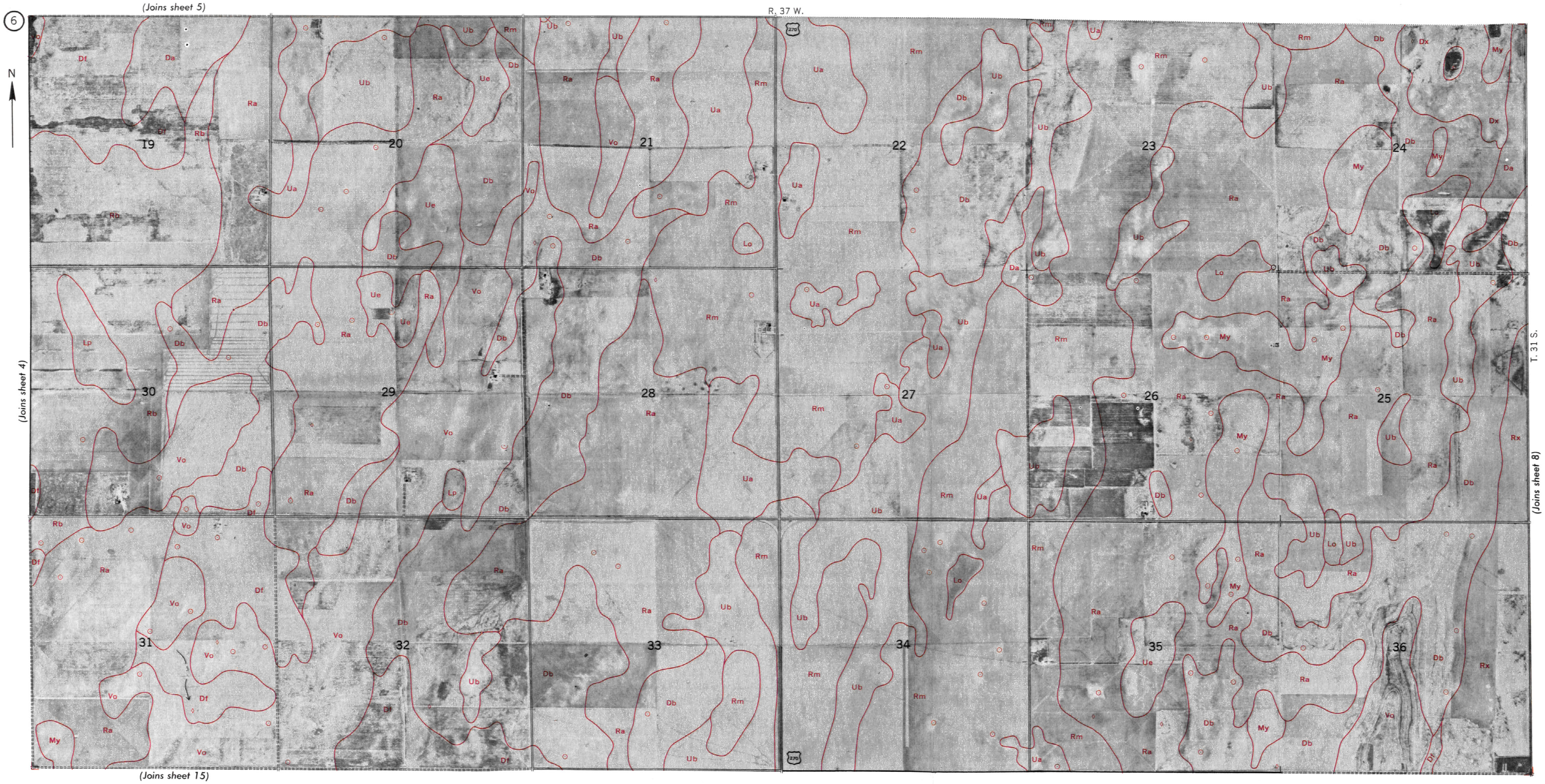
Range, township, and section corners shown on this map are indefinite.

0 ½ 1 mile

Scale 1:20 000

0 5000 feet

STEVENS COUNTY, KANSAS — SHEET NUMBER 6

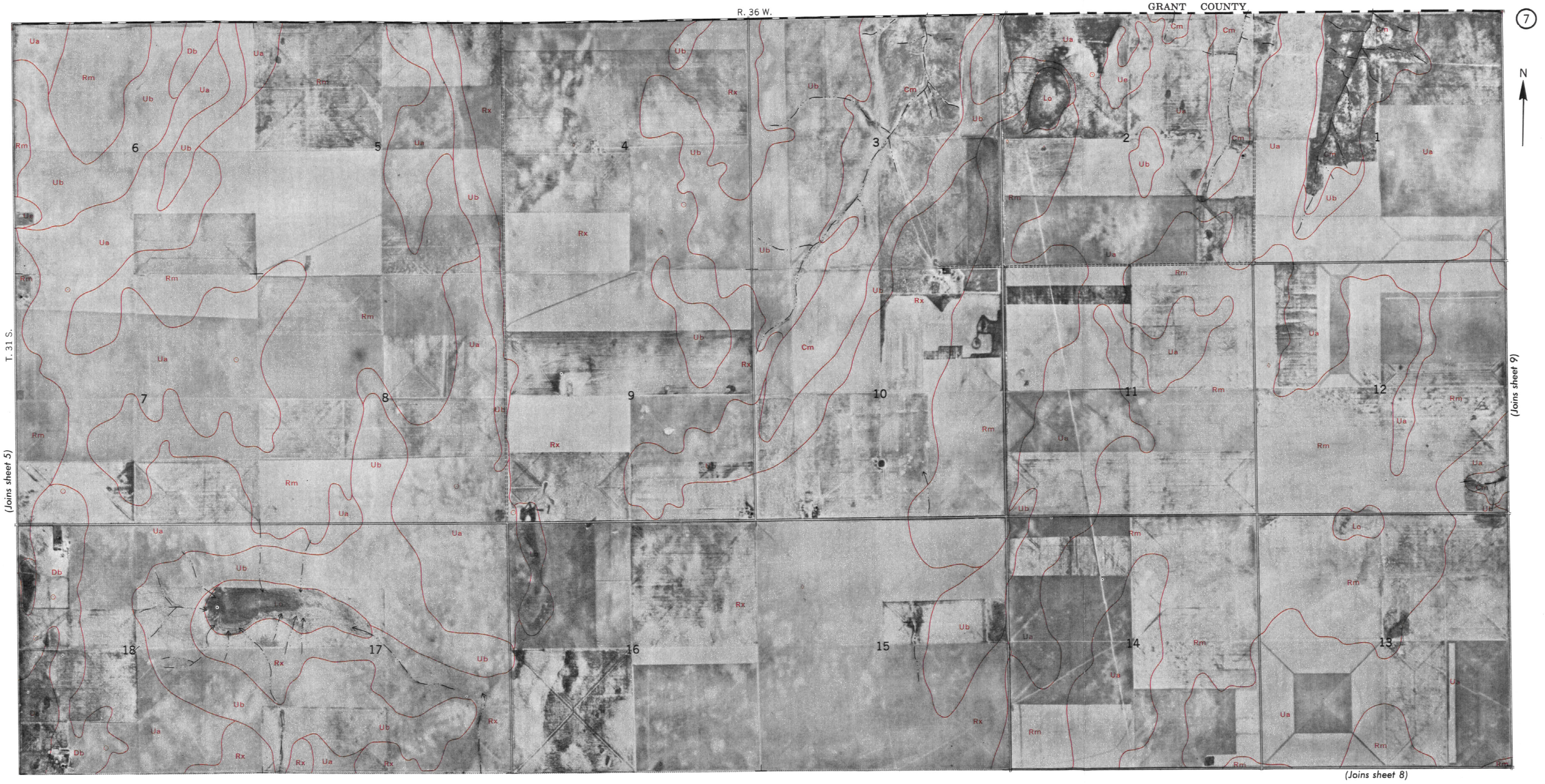


0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

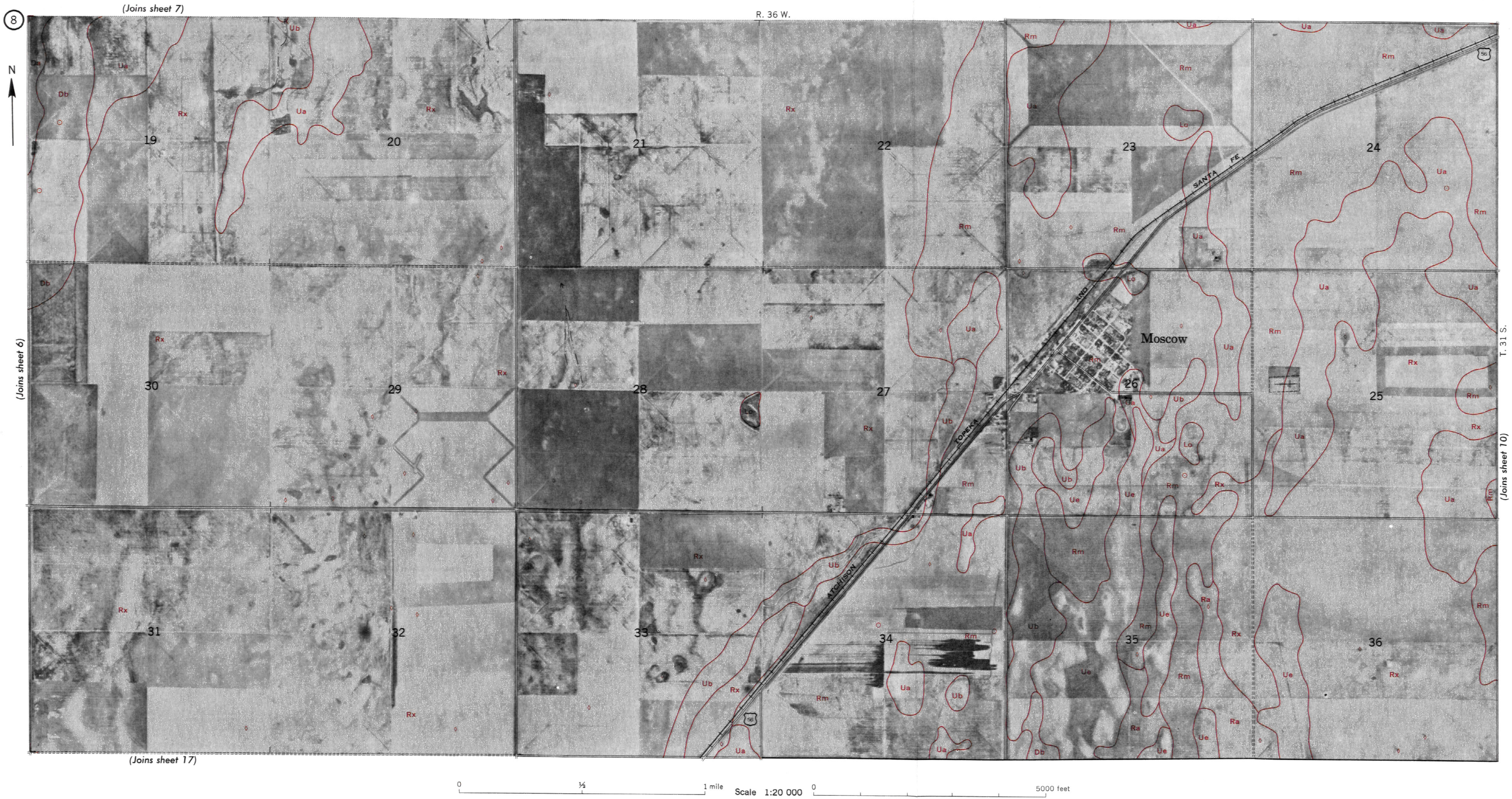
STEVENS COUNTY, KANSAS — SHEET NUMBER 7

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.

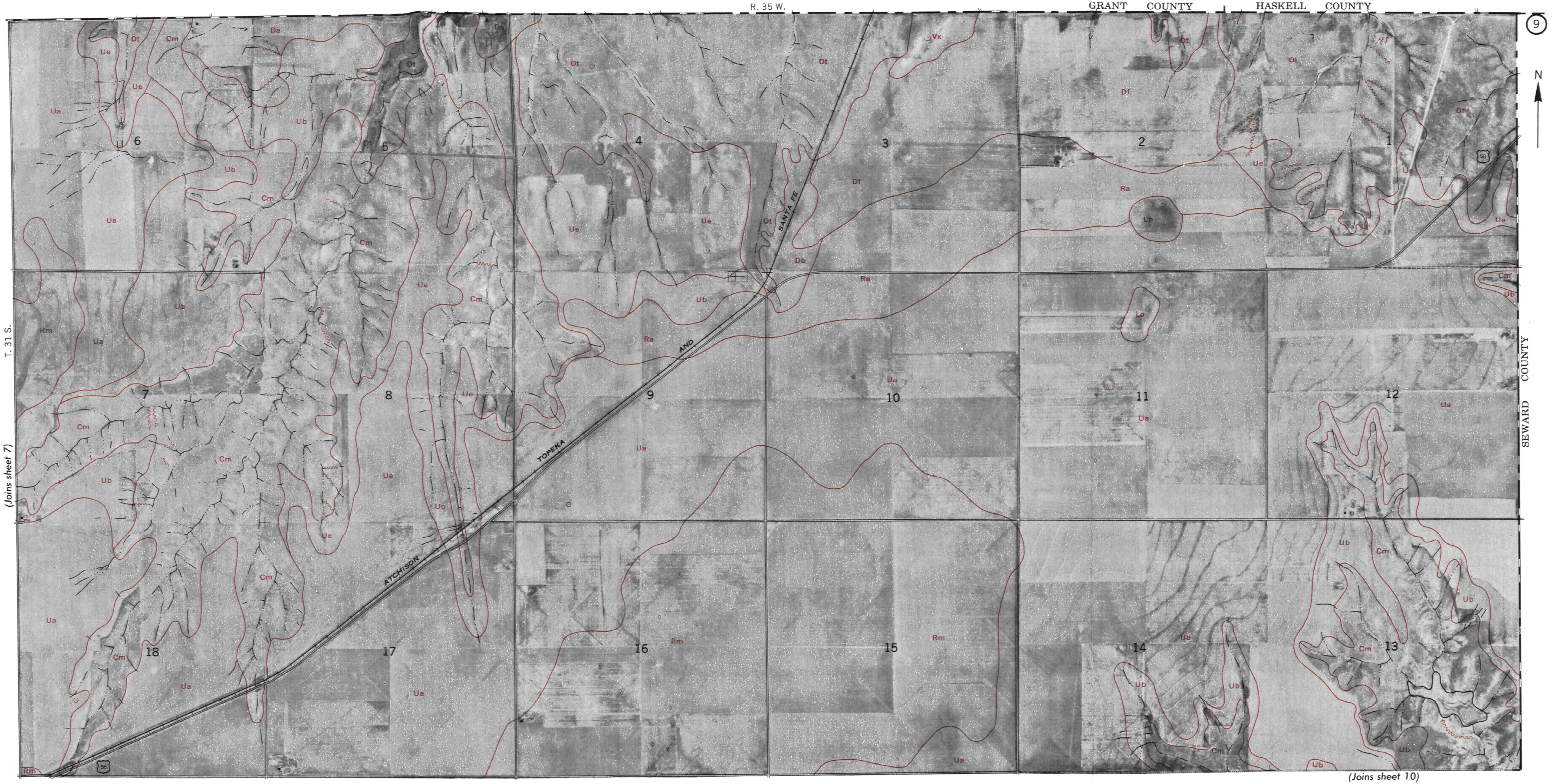


0 ½ 1 mile Scale 1:20 000 0 5000 feet

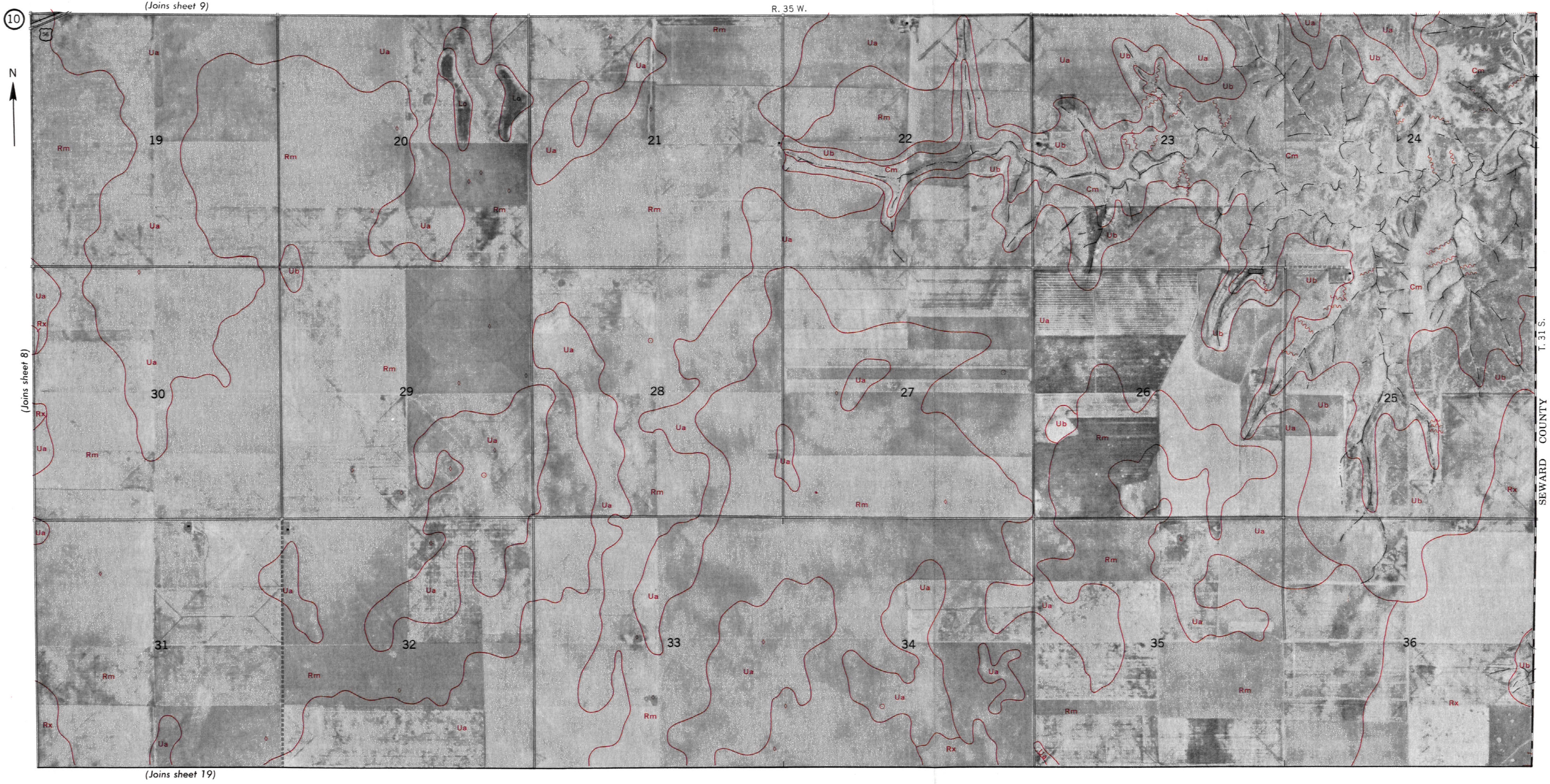

8
(Joins sheet 7)
R. 36 W.
N
(Joins sheet 6)
T. 31 S.
(Joins sheet 10)
(Joins sheet 17)
19
20
21
22
23
24
30
29
28
27
26
25
31
32
33
34
35
36
Moscow
SANTA FE
AND
TOPEKA
ATCHISON
56
Ua
Ub
Ue
Db
Rx
Rm
Ra
Lo
0
½
1 mile
Scale 1:20 000
0
5000 feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 mile Scale 1:20 000 0 5000 feet



0 ½ 1 mile Scale 1:20 000 0 5000 feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

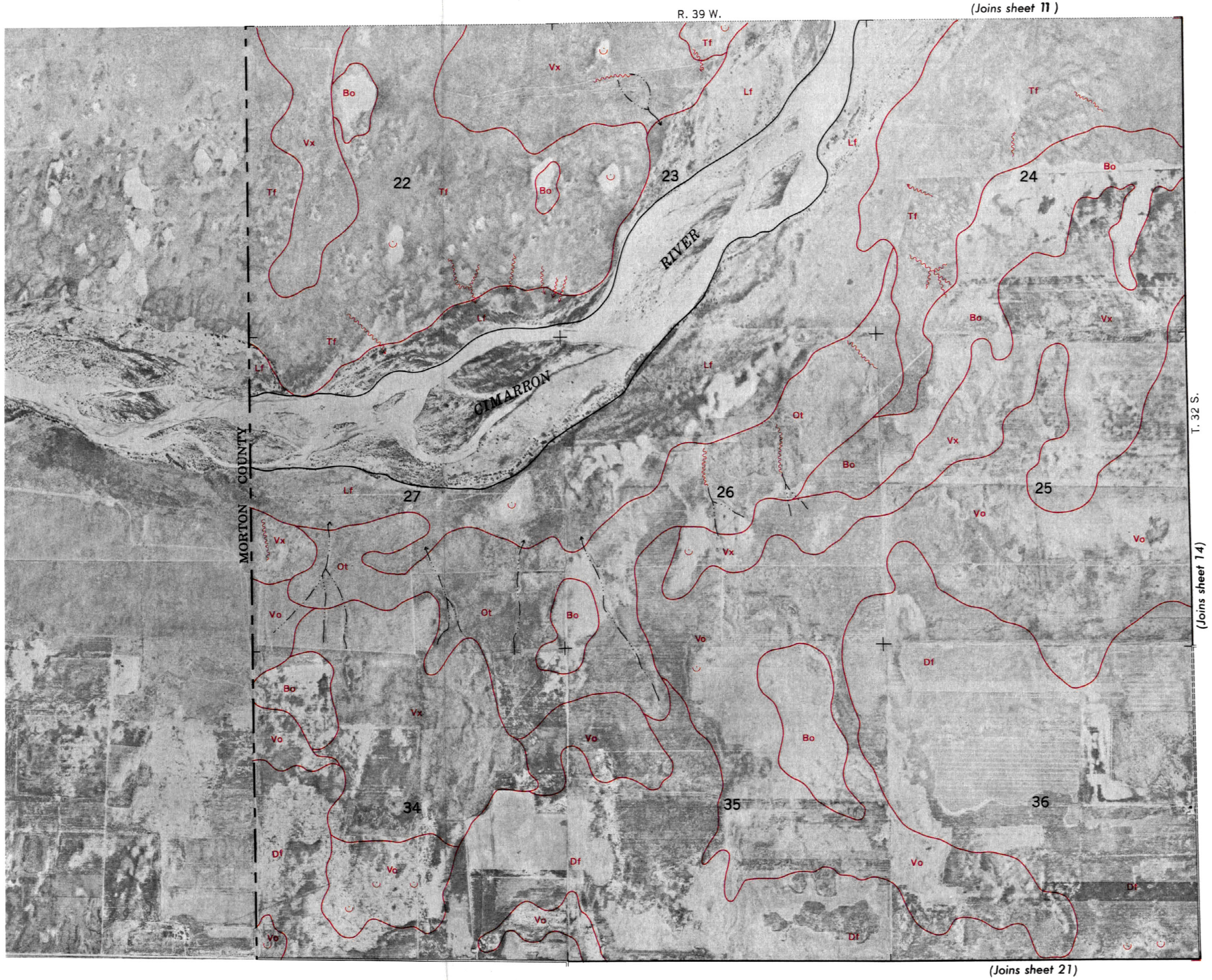
Range, township, and section corners shown on this map are indefinite.

0 ½ 1 mile Scale 1:20 000 0 5000 feet

STEVENS COUNTY, KANSAS — SHEET NUMBER 12

12

N

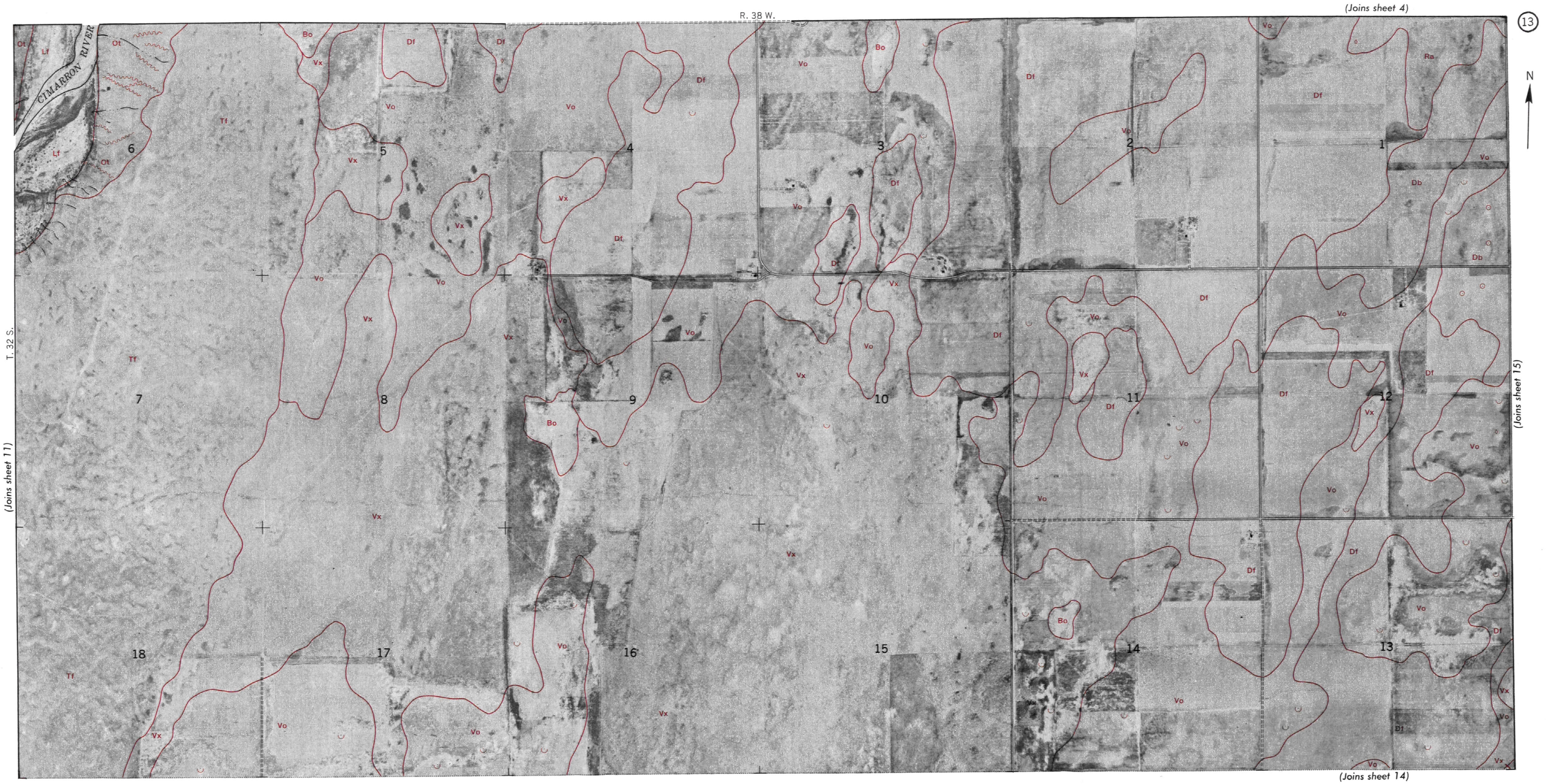


0 ½ 1 mile Scale 1:20 000 0 5000 feet

STEVENS COUNTY, KANSAS — SHEET NUMBER 13

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 mile Scale 1:20 000 0 5000 feet

14

N

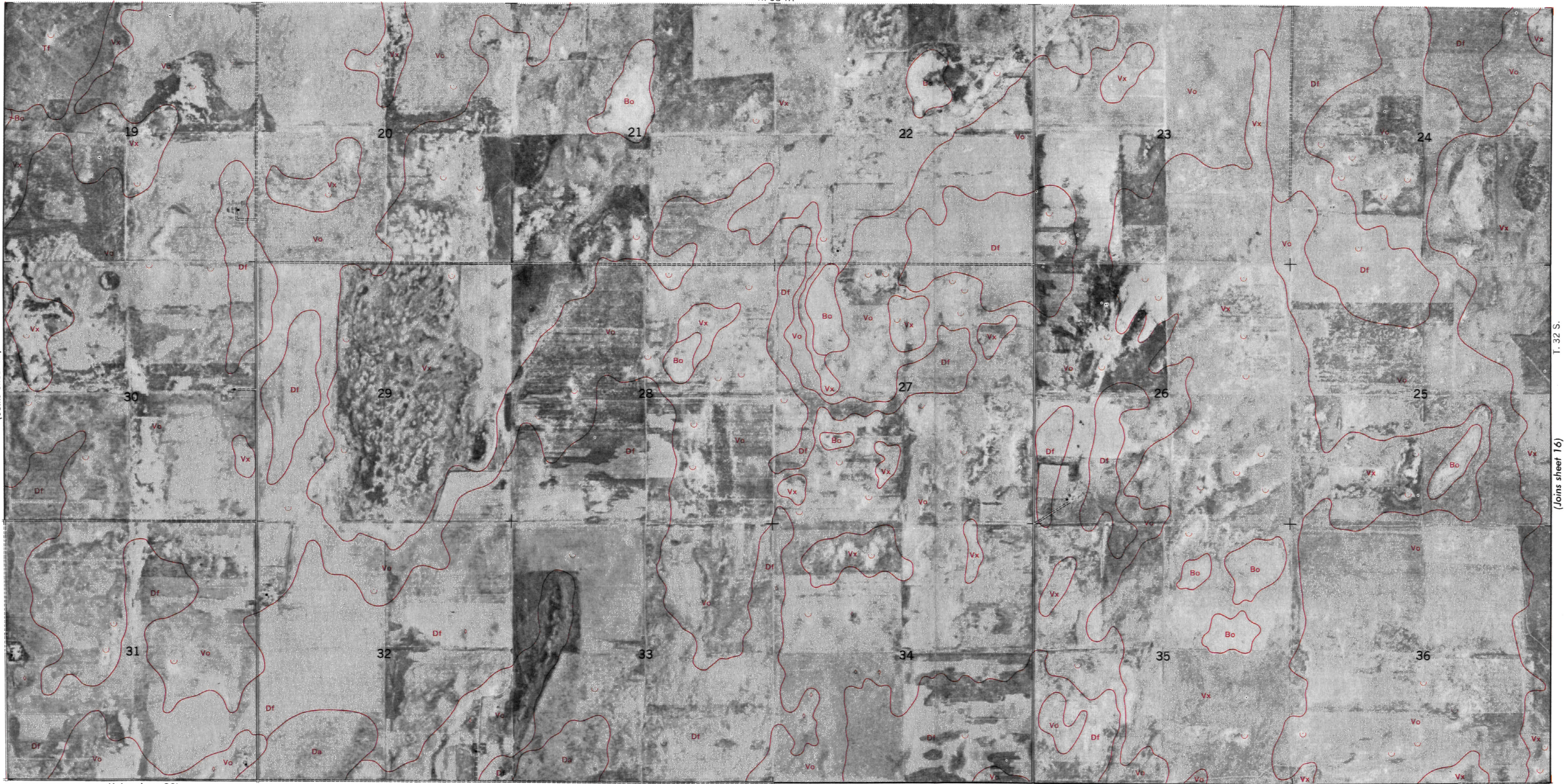
(Joins sheet 13)

R. 38 W.

(Joins Sheet 12)

T. 32 S.

(Joins sheet 16)



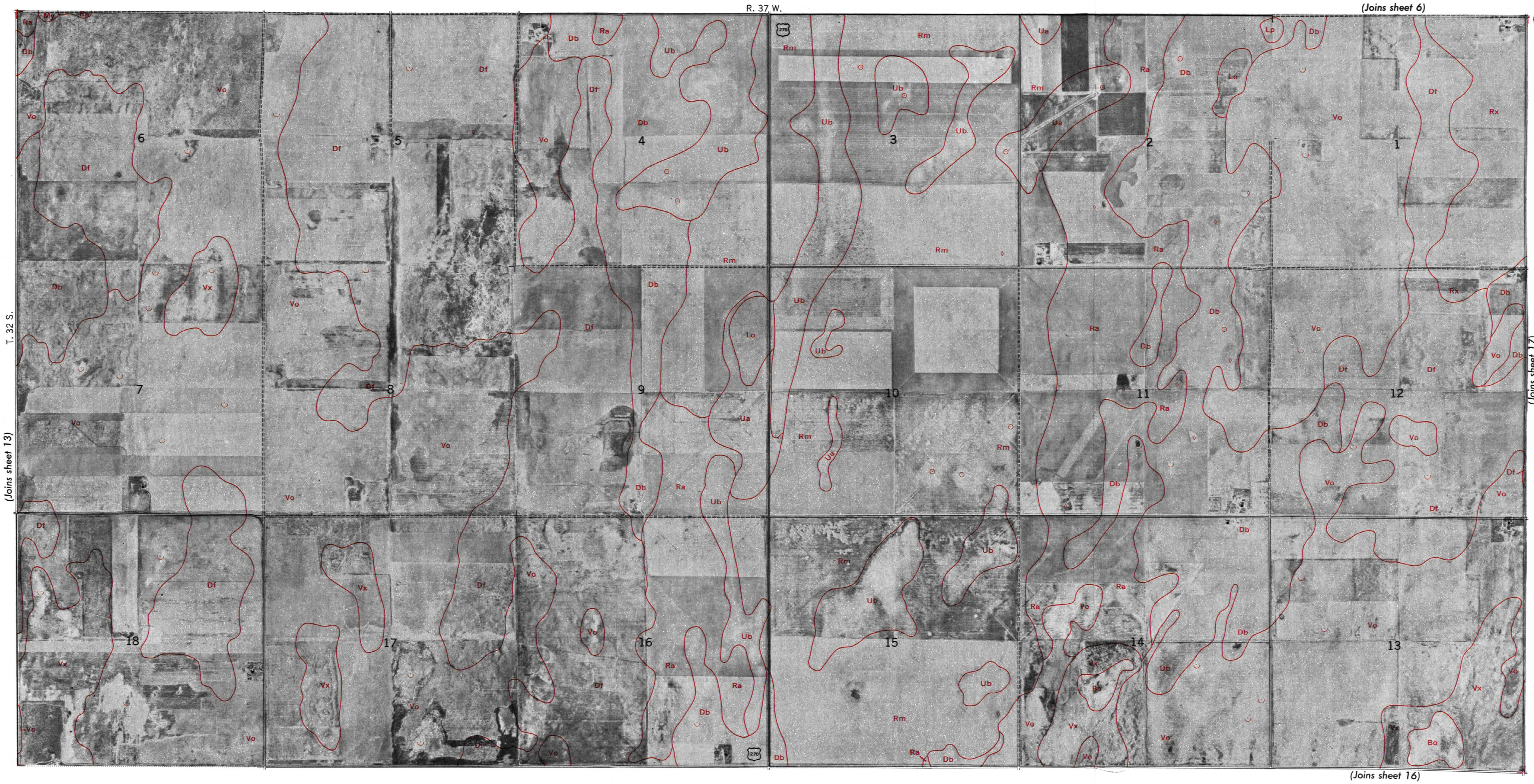
(Joins sheet 23)

0 ½ 1 mile

Scale 1:20 000

0 5 000 Feet

STEVENS COUNTY, KANSAS — SHEET NUMBER 15



0 ½ 1 Mile

Scale 1:20000

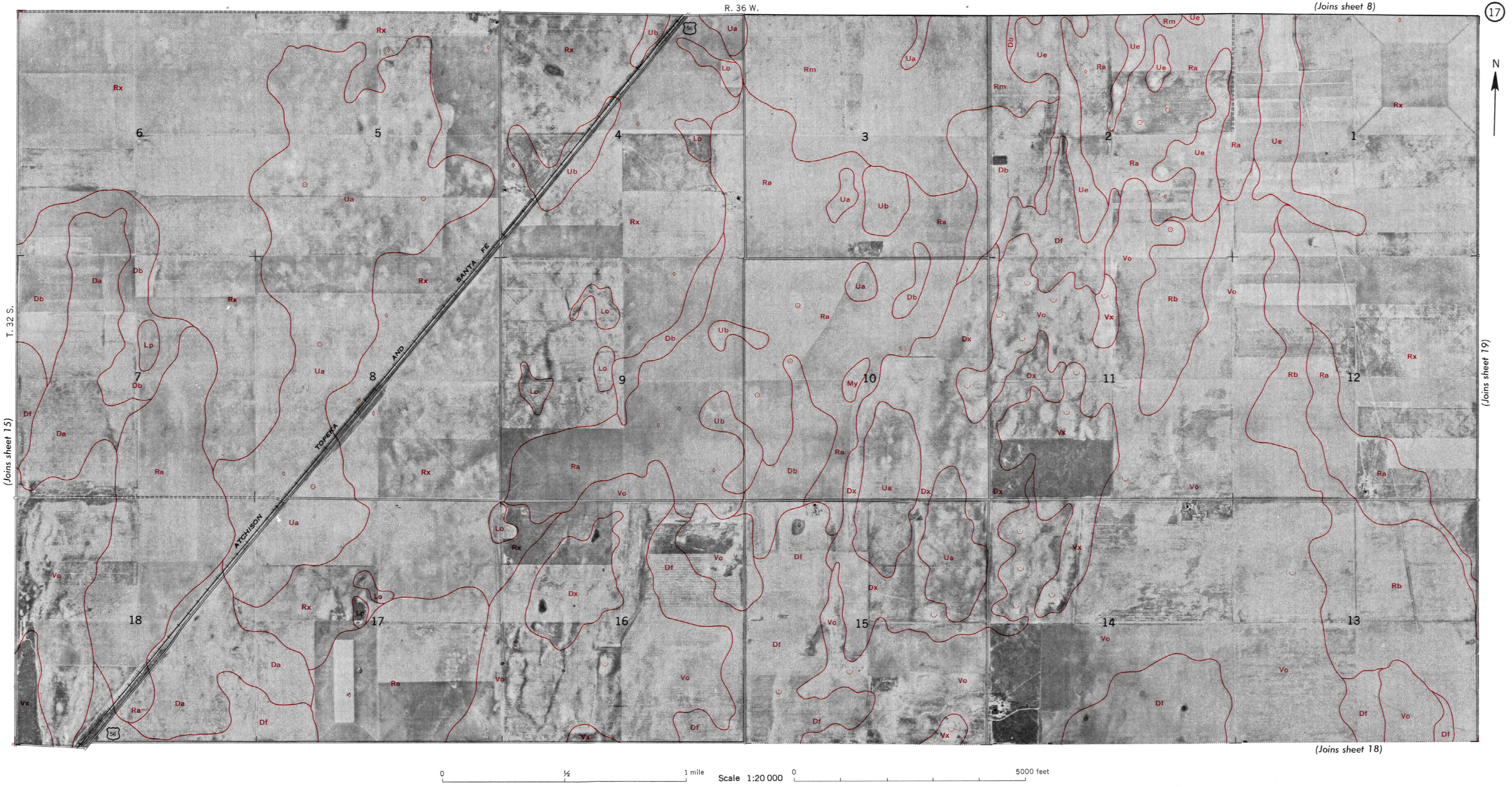
0 5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.

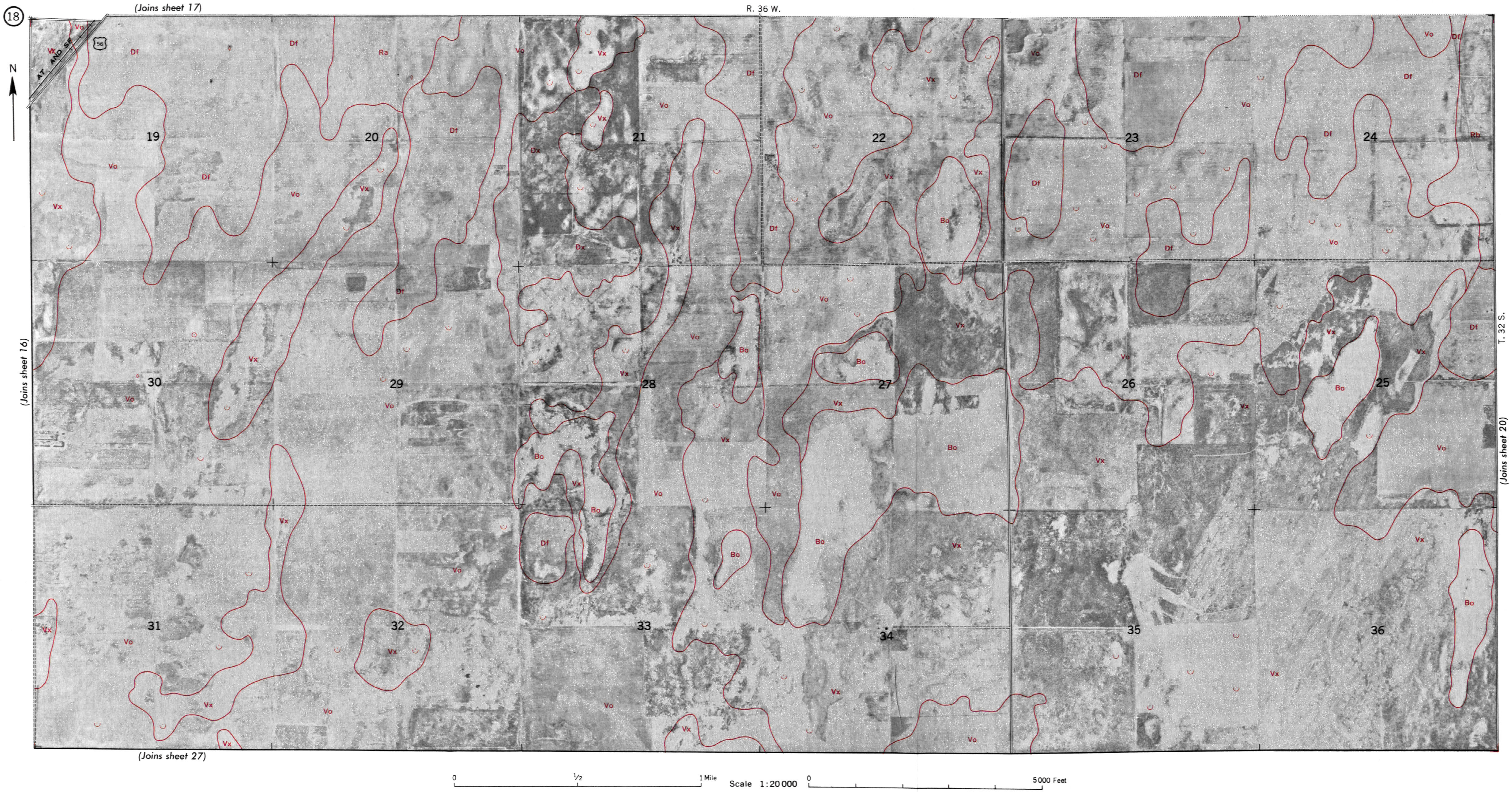
0 ½ 1 mile Scale 1:20 000 0 5000 feet

STEVENS COUNTY, KANSAS — SHEET NUMBER 17

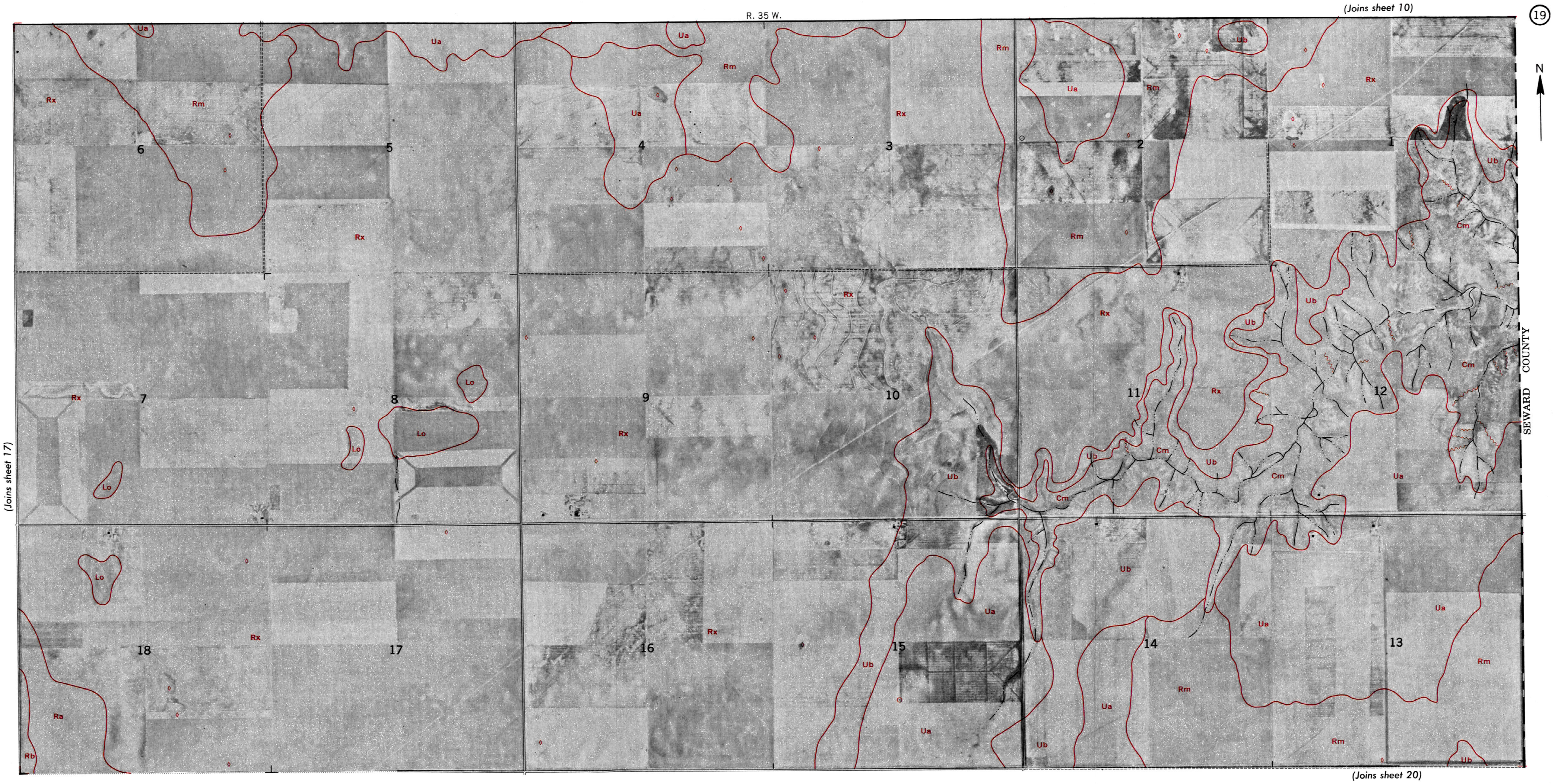


This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.


18
(Joins sheet 17)
R. 36 W.
N
AT AND SF
56
(Joins sheet 16)
T. 32 S.
(Joins sheet 20)
(Joins sheet 27)
19
20
21
22
23
24
30
29
28
27
26
25
31
32
33
34
35
36
Df
Vo
Vx
Ra
Dx
Bo
Rb
0
1/2
1 Mile
Scale 1:20 000
0
5000 Feet

STEVENS COUNTY, KANSAS — SHEET NUMBER 19



0 ½ 1 mile Scale 1:20 000 0 5000 feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.

STEVENS COUNTY, KANSAS — SHEET NUMBER 20

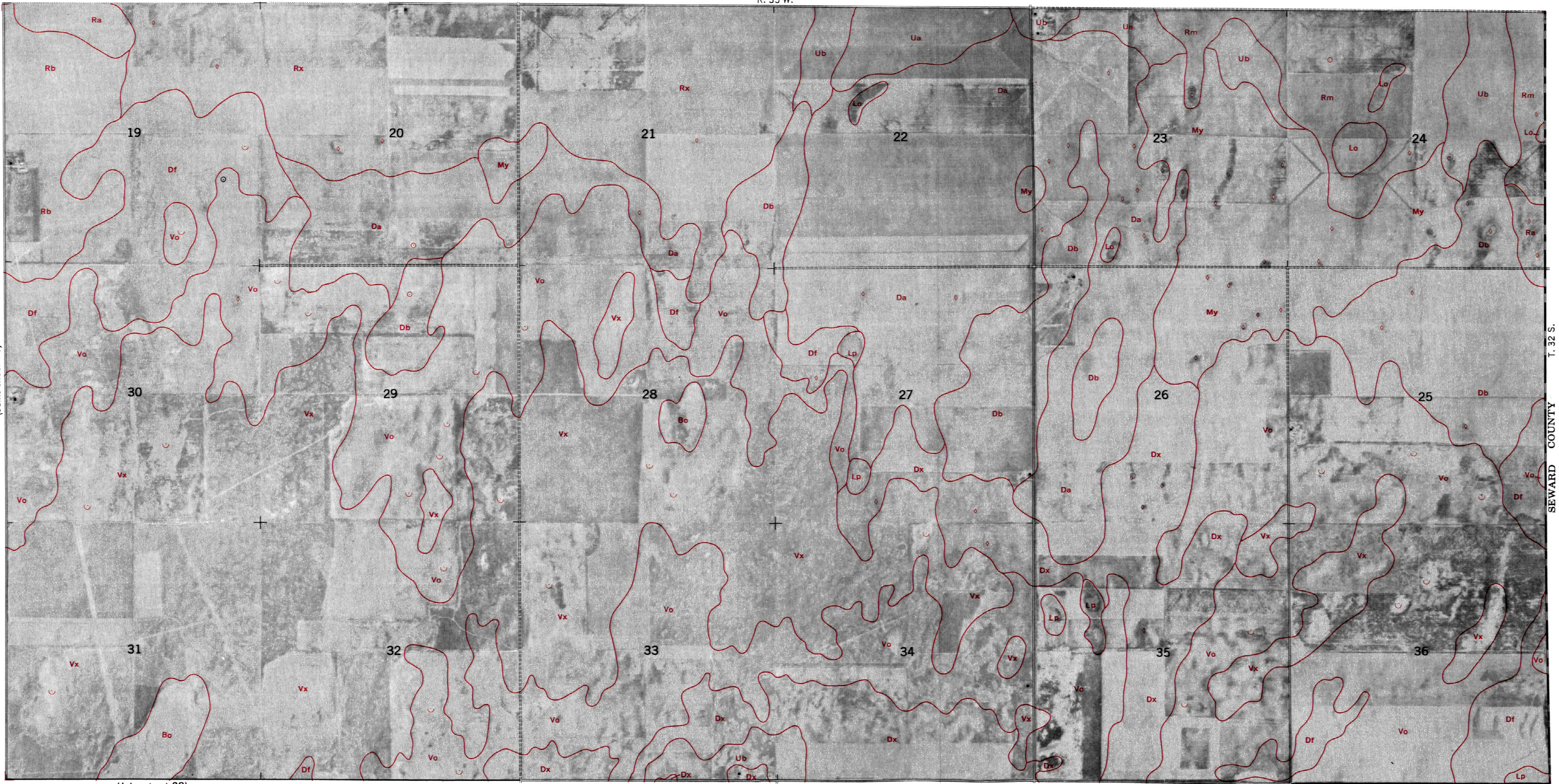
(20)

(Joins sheet 19)

R. 35 W.

N

(Joins sheet 18)



T. 32 S.

SEWARD COUNTY

(Joins sheet 29)

0 ½ 1 mile Scale 1:20 000 0 5000 feet

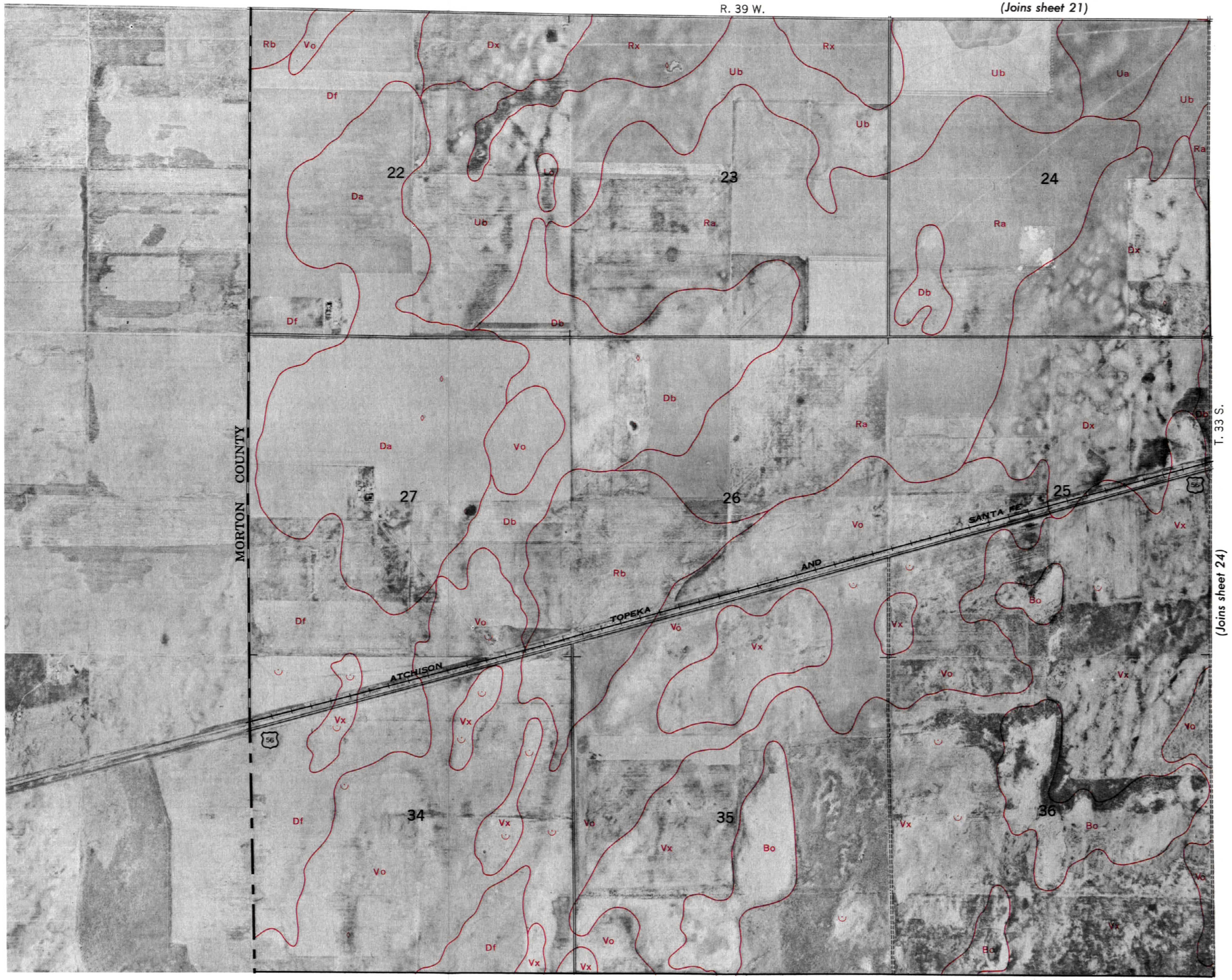
This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 mile Scale 1:20 000 0 5000 feet

22

N

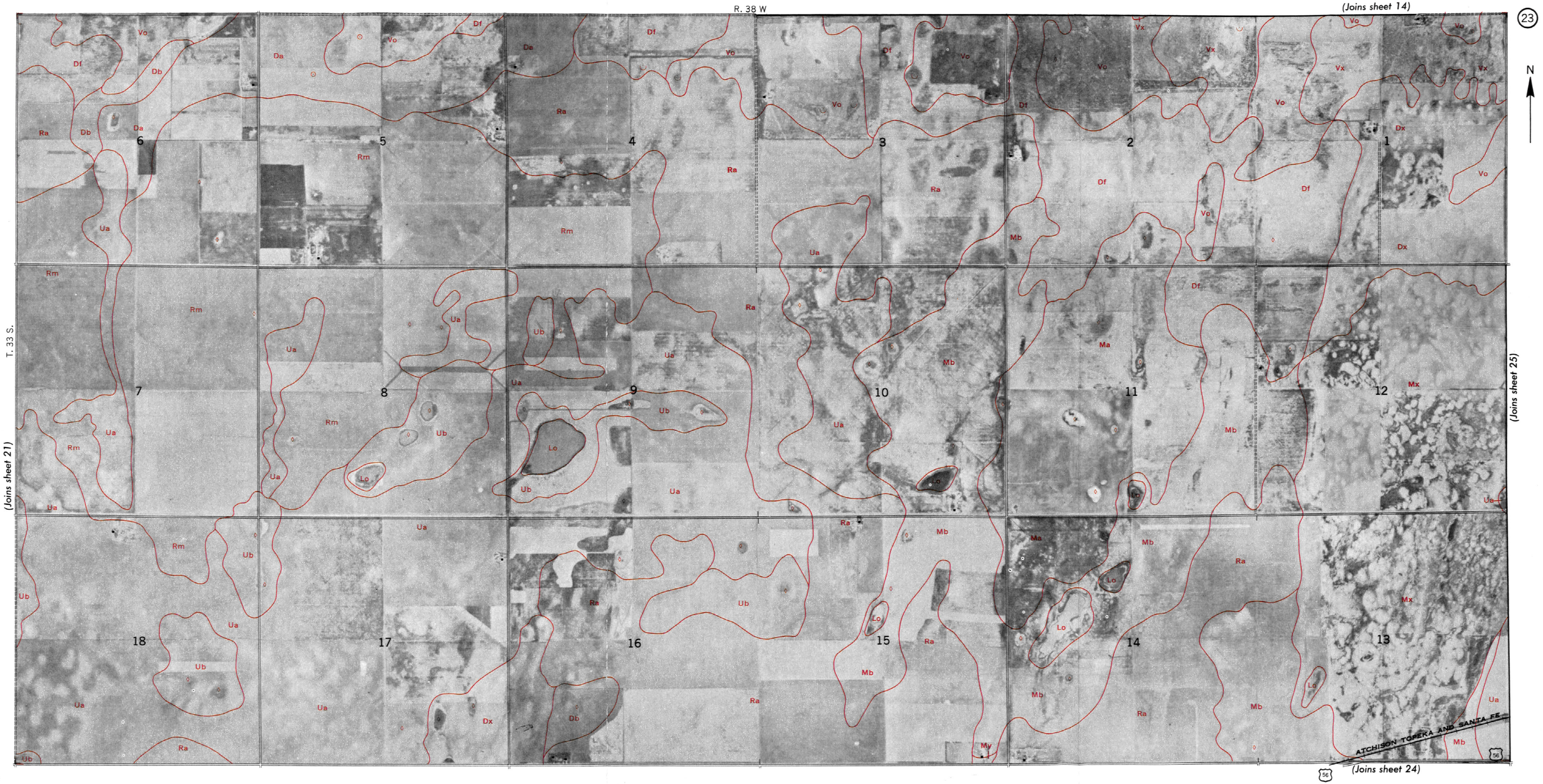


0 ½ 1 mile Scale 1:20 000 0 5 000 Feet

STEVENS COUNTY, KANSAS — SHEET NUMBER 23

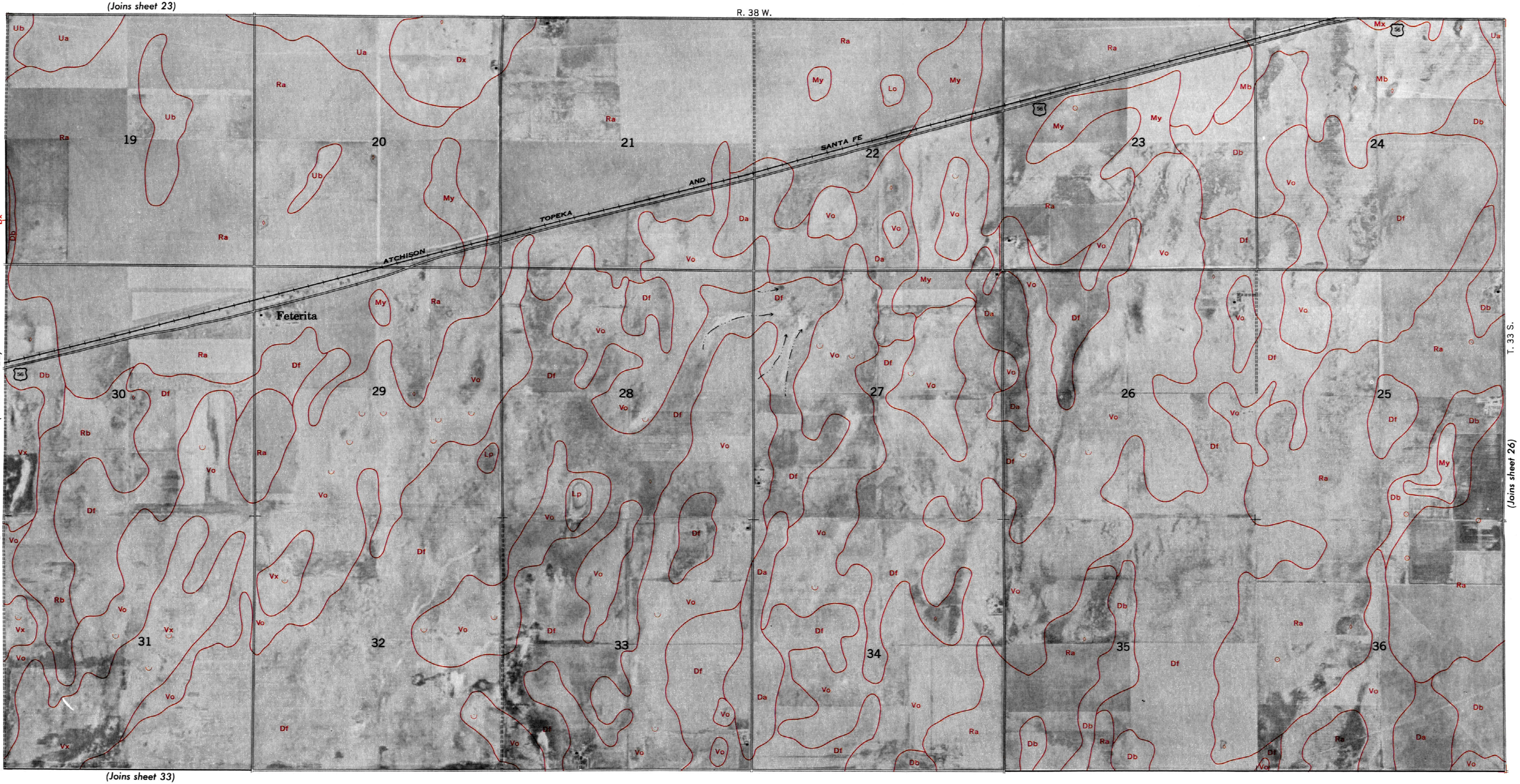
This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 mile Scale 1:20 000 0 5000 feet

STEVENS COUNTY, KANSAS — SHEET NUMBER 24



0 ½ 1 mile Scale 1:20 000 0 5000 feet

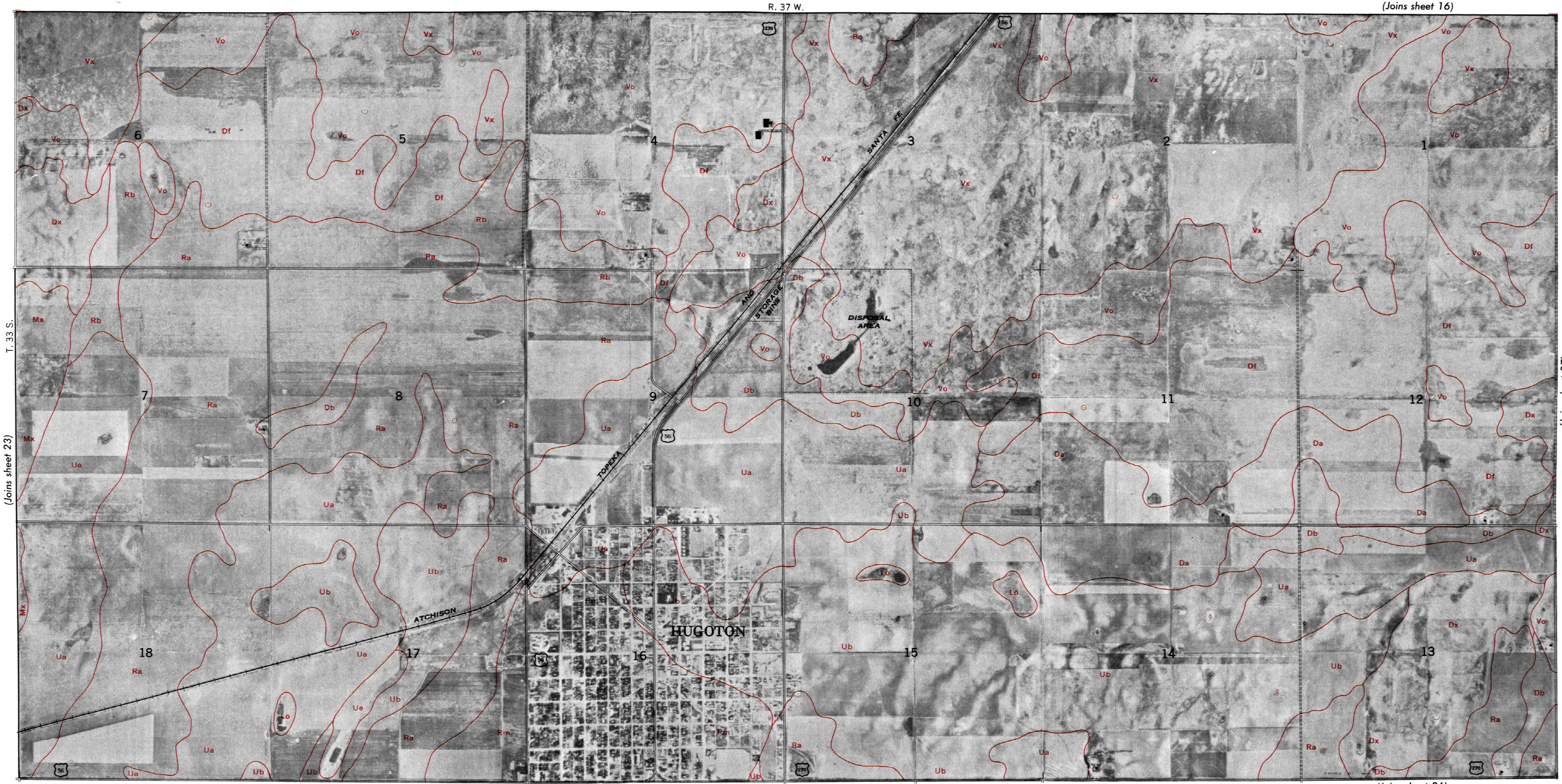
R. 37 W.

(Joins sheet 16)

T. 33 S.

(Joins sheet 23)

(Joins sheet 27)



(Joins sheet 26)

0 ½ 1 mile

Scale 1:20 000

0 5000 feet

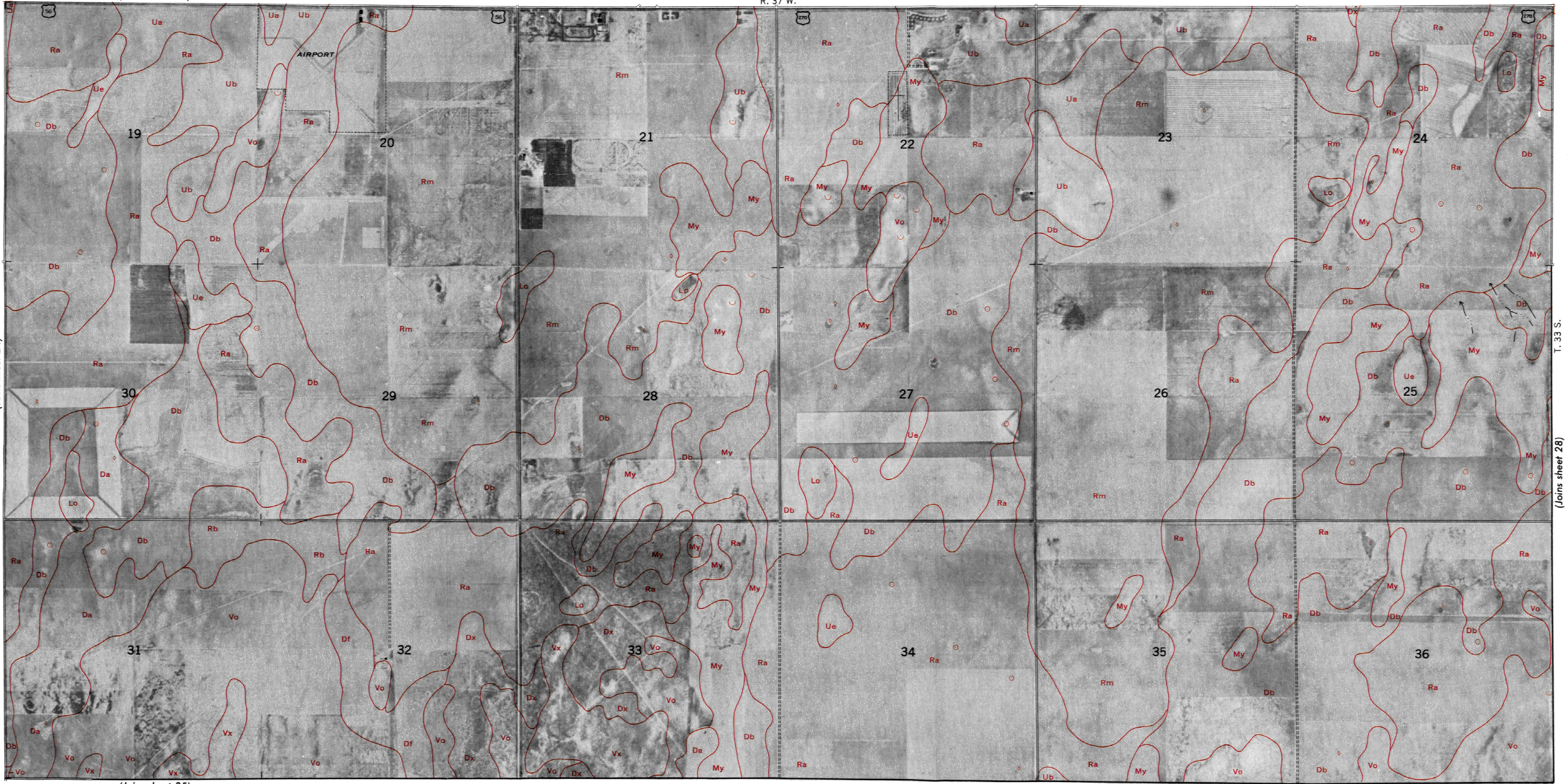
This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.

26

(Joins sheet 25)

R. 37 W.



(Joins sheet 24)

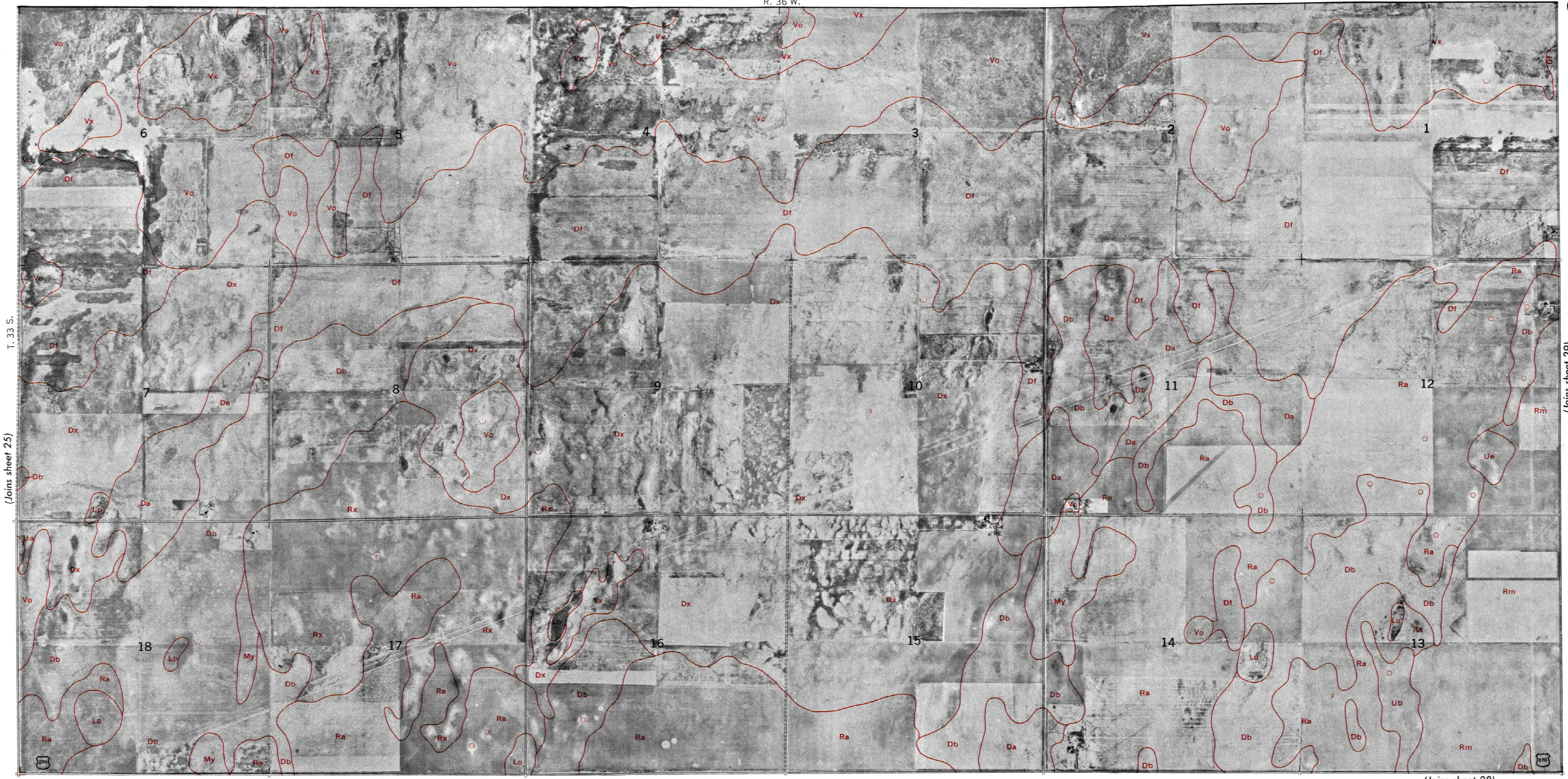
(Joins sheet 28)

(Joins sheet 35)

0 ½ 1 mile Scale 1:20 000 0 5000 feet

(Joins sheet 18)

27



(Joins sheet 25)

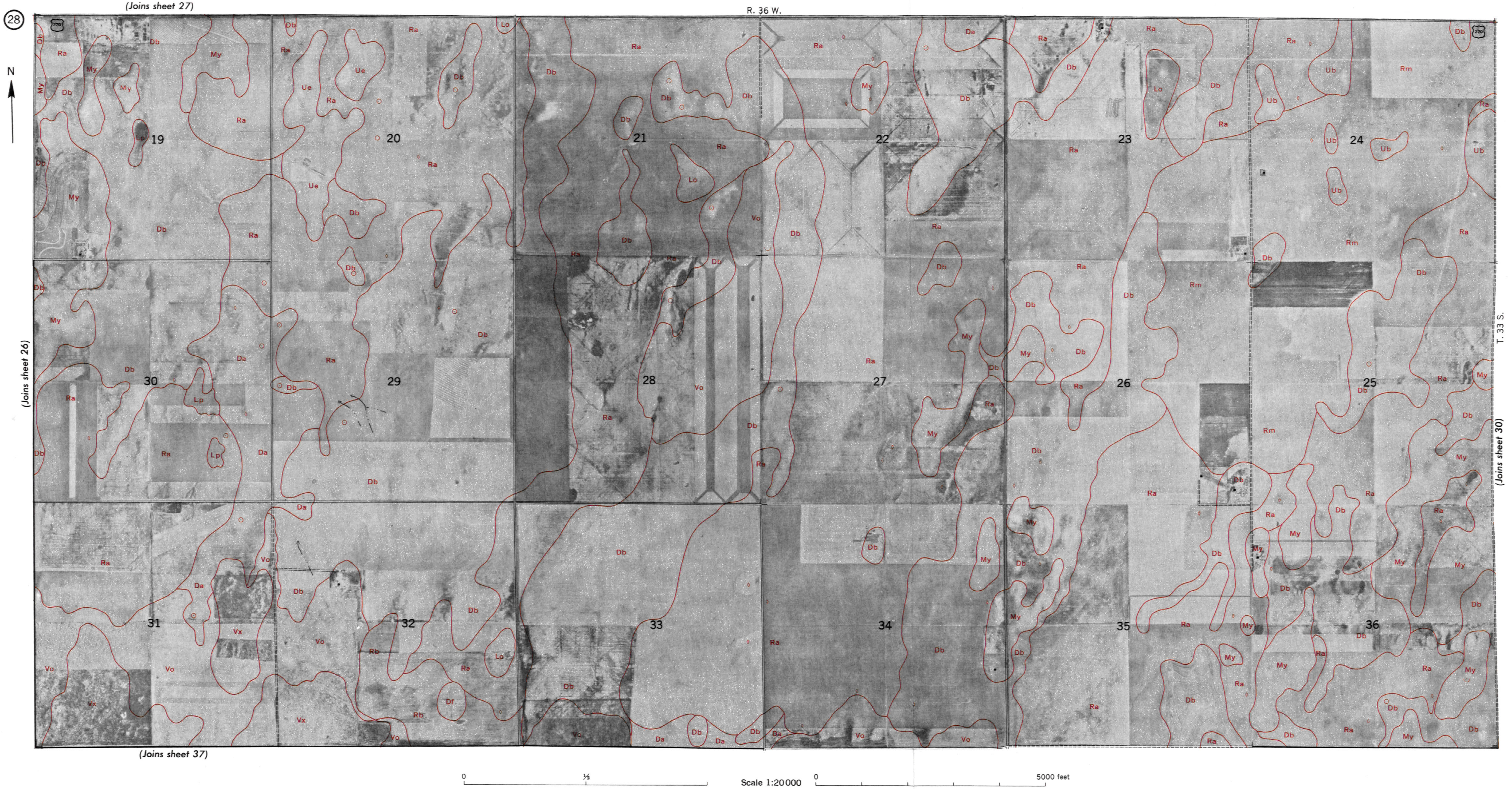
(Joins sheet 29)

(Joins sheet 28)

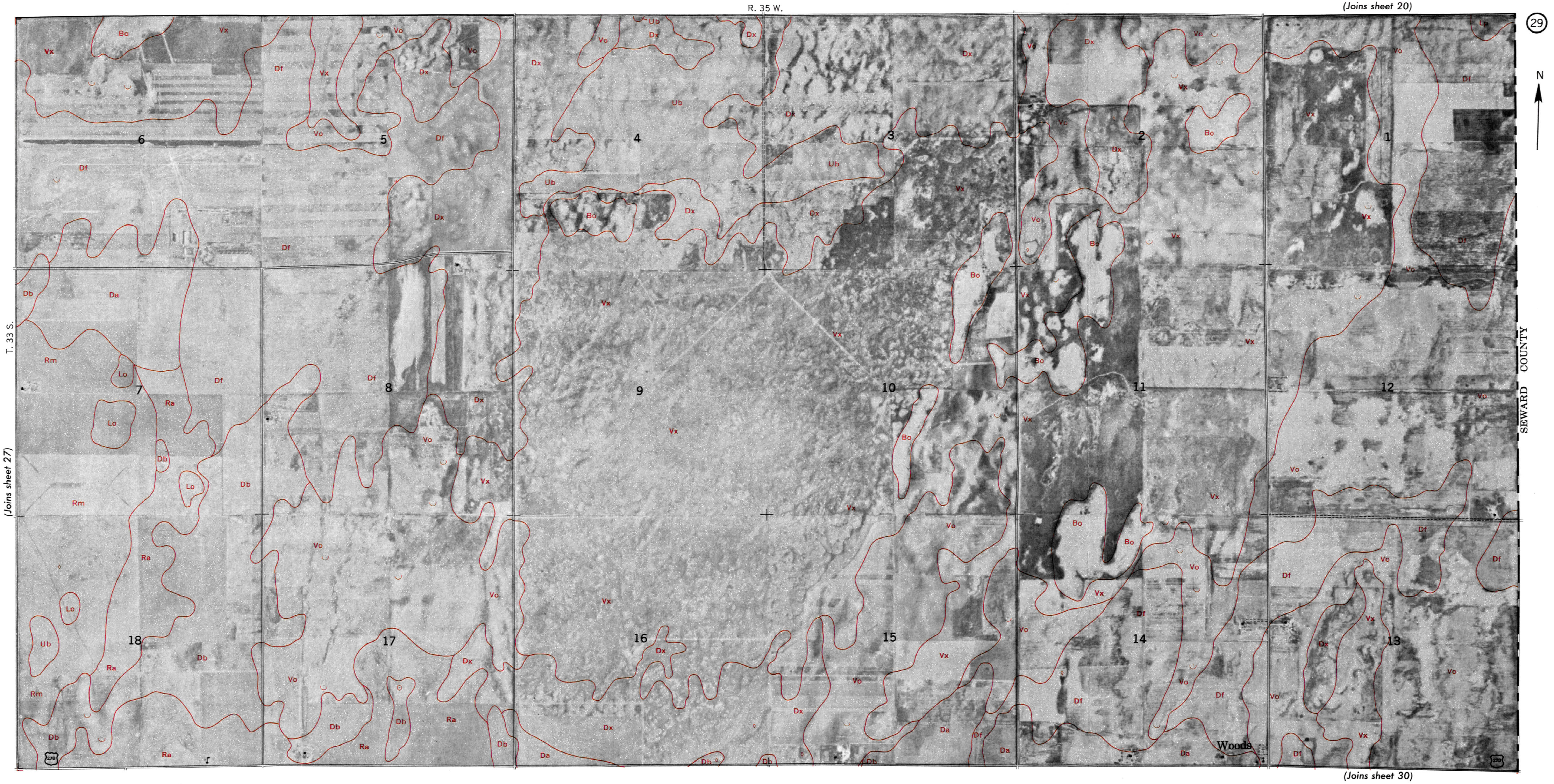
This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 mile Scale 1:20000 0 5000 feet


28
(Joins sheet 27)
R. 36 W.
N
(Joins sheet 26)
(Joins sheet 30)
T. 33 S.
(Joins sheet 37)
19
20
21
22
23
24
30
29
28
27
26
25
31
32
33
34
35
36
0
½
Scale 1:20000
0
5000 feet

STEVENS COUNTY, KANSAS — SHEET NUMBER 29

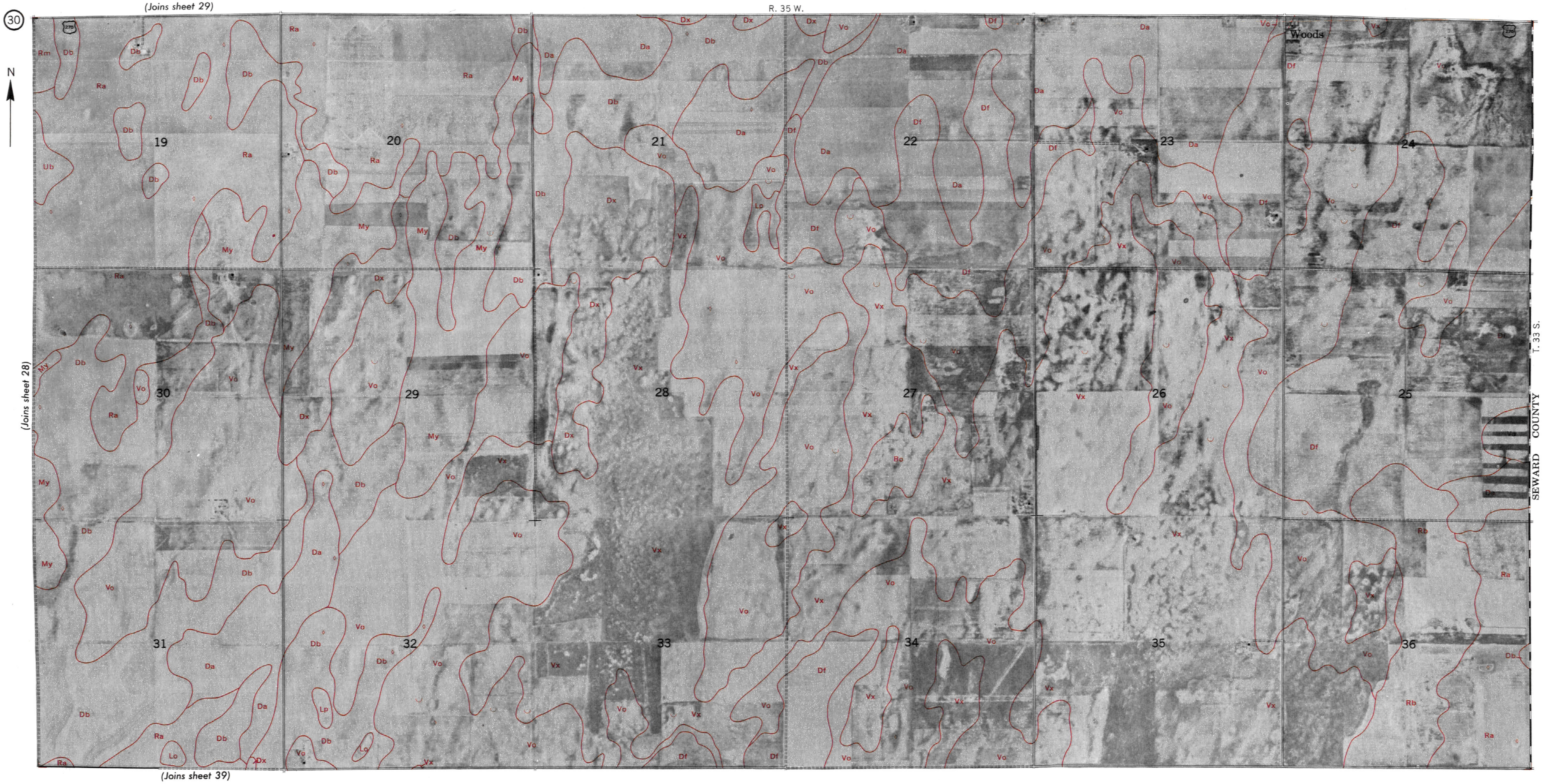


0 ½ 1 mile Scale 1:20 000 0 5000 feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.

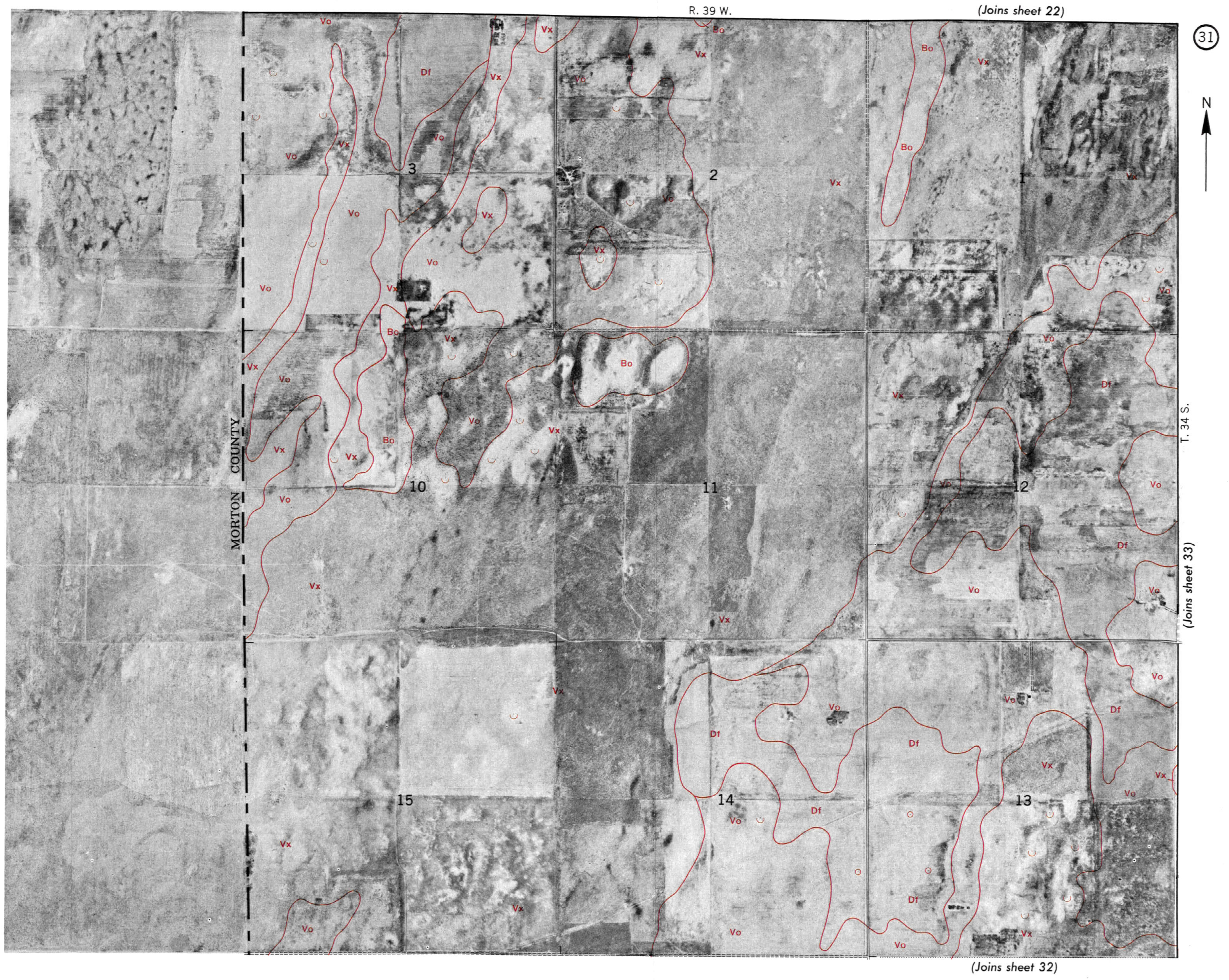
STEVENS COUNTY, KANSAS — SHEET NUMBER 30



0 ½ 1 mile Scale 1:20 000 0 5000 feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.



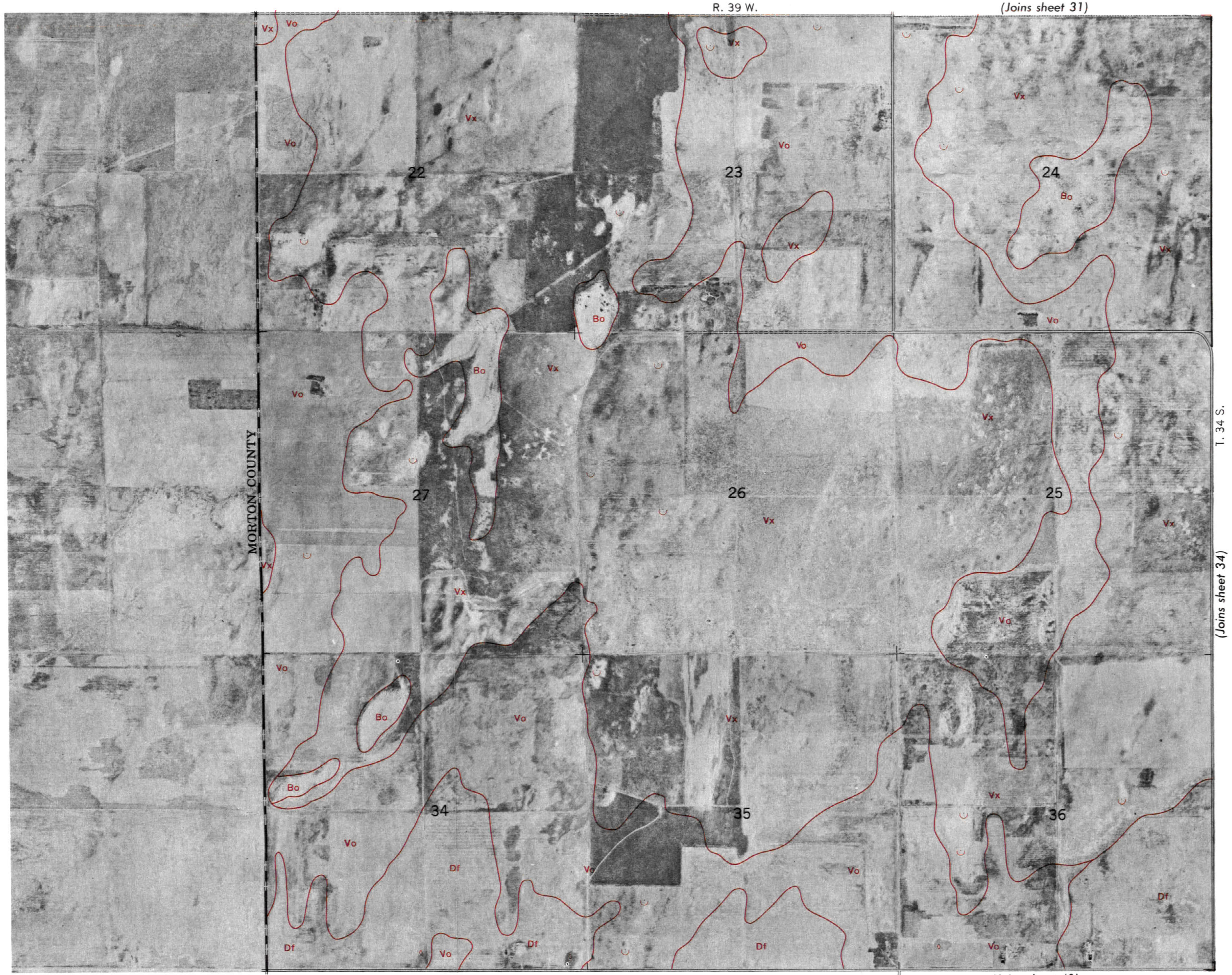
0 ½ 1 mile

Scale 1:20 000

0 5000 feet

32

N

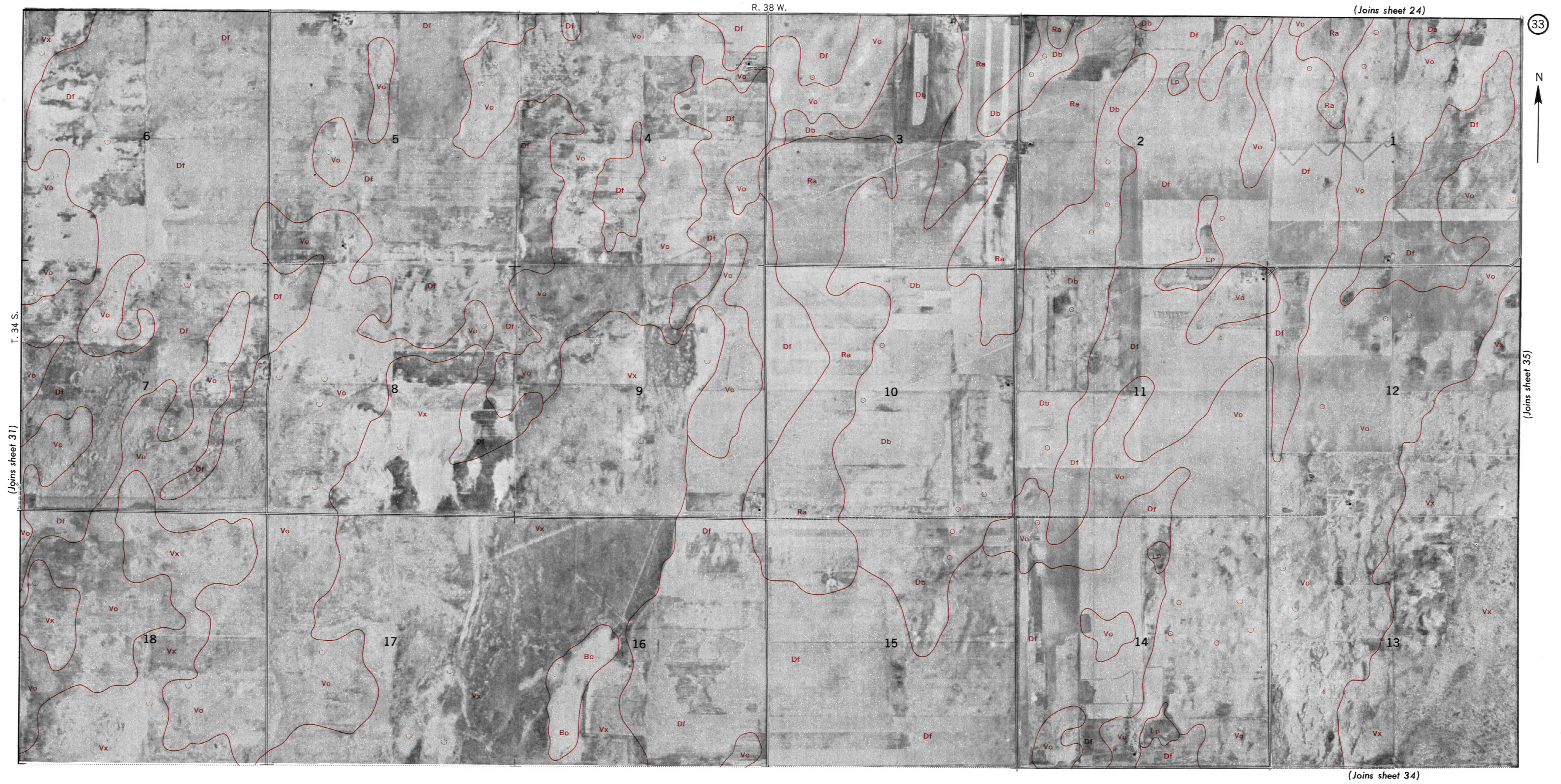


0 ½ 1 mile Scale 1:20 000 0 5000 feet

STEVENS COUNTY, KANSAS — SHEET NUMBER 33

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.

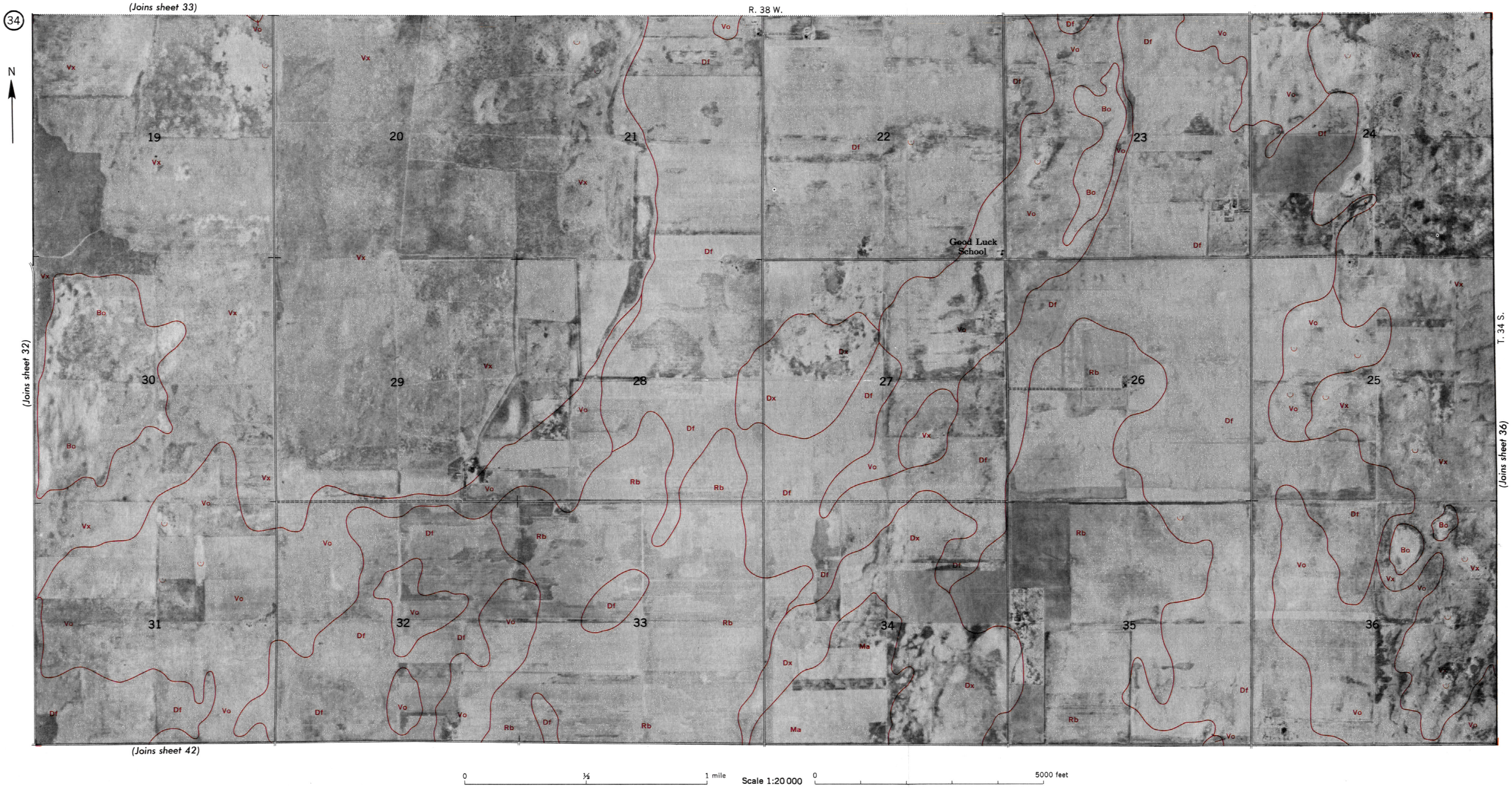


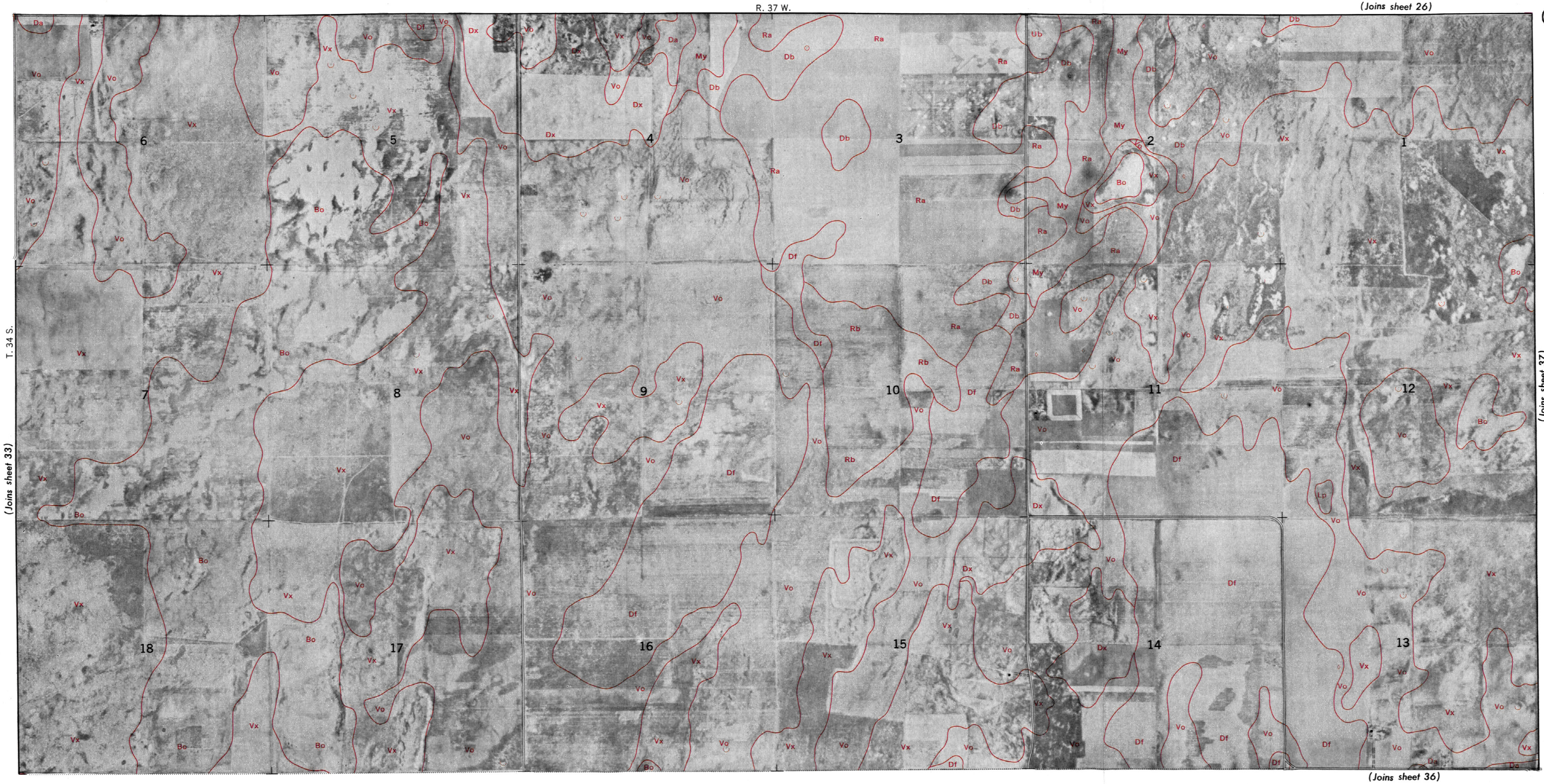
0 ½ 1 mile

Scale 1:20 000

0 5000 feet

STEVENS COUNTY, KANSAS — SHEET NUMBER 34





This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 mile Scale 1:20 000 0 5000 feet

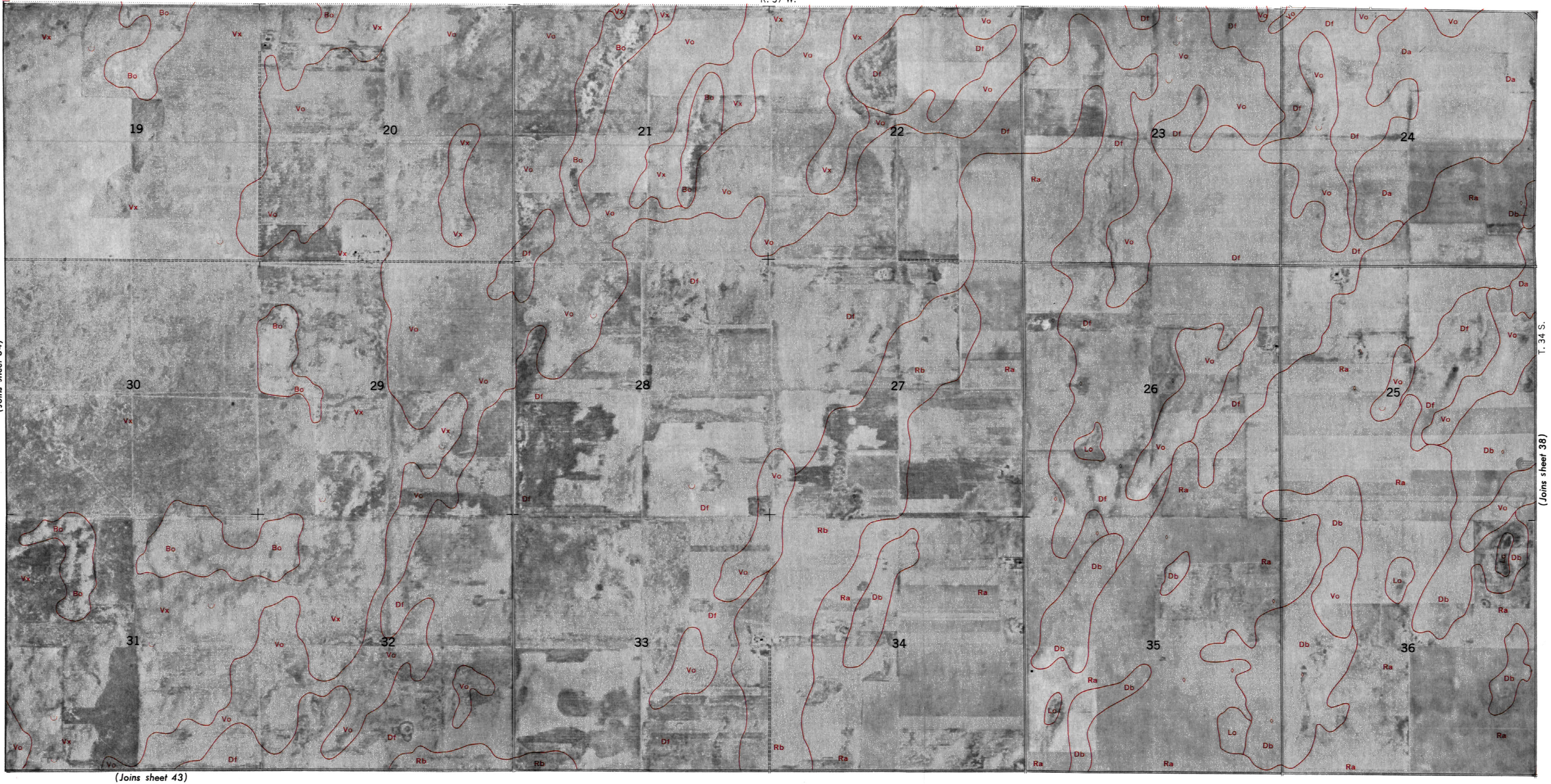
STEVENS COUNTY, KANSAS — SHEET NUMBER 36

36

(Joins sheet 35)

R. 37 W.

(Joins sheet 34)



T. 34 S.

(Joins sheet 38)

(Joins sheet 43)

0 ½ 1 mile

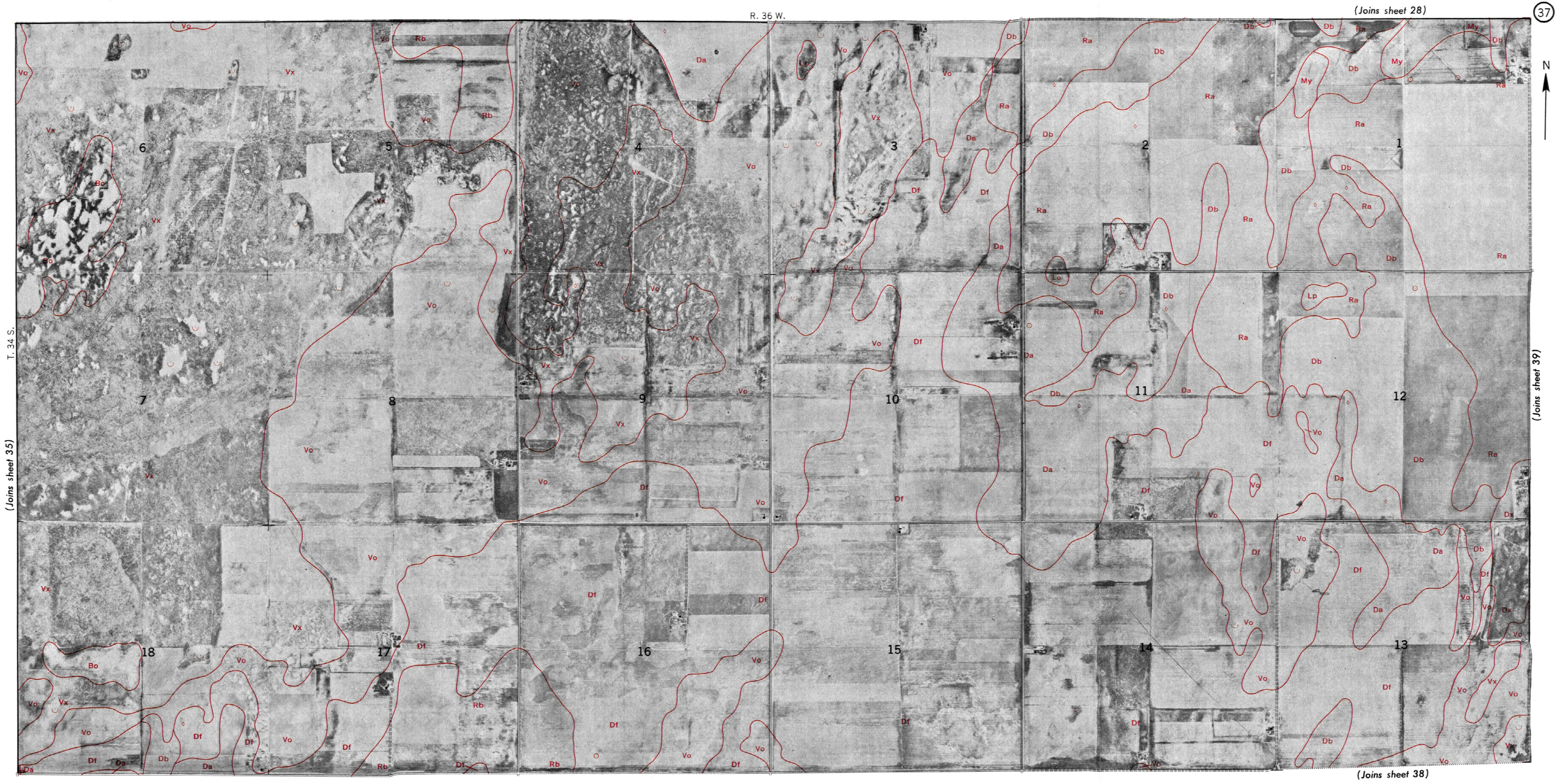
Scale 1:20 000

0 5000 feet

STEVENS COUNTY, KANSAS — SHEET NUMBER 37

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.

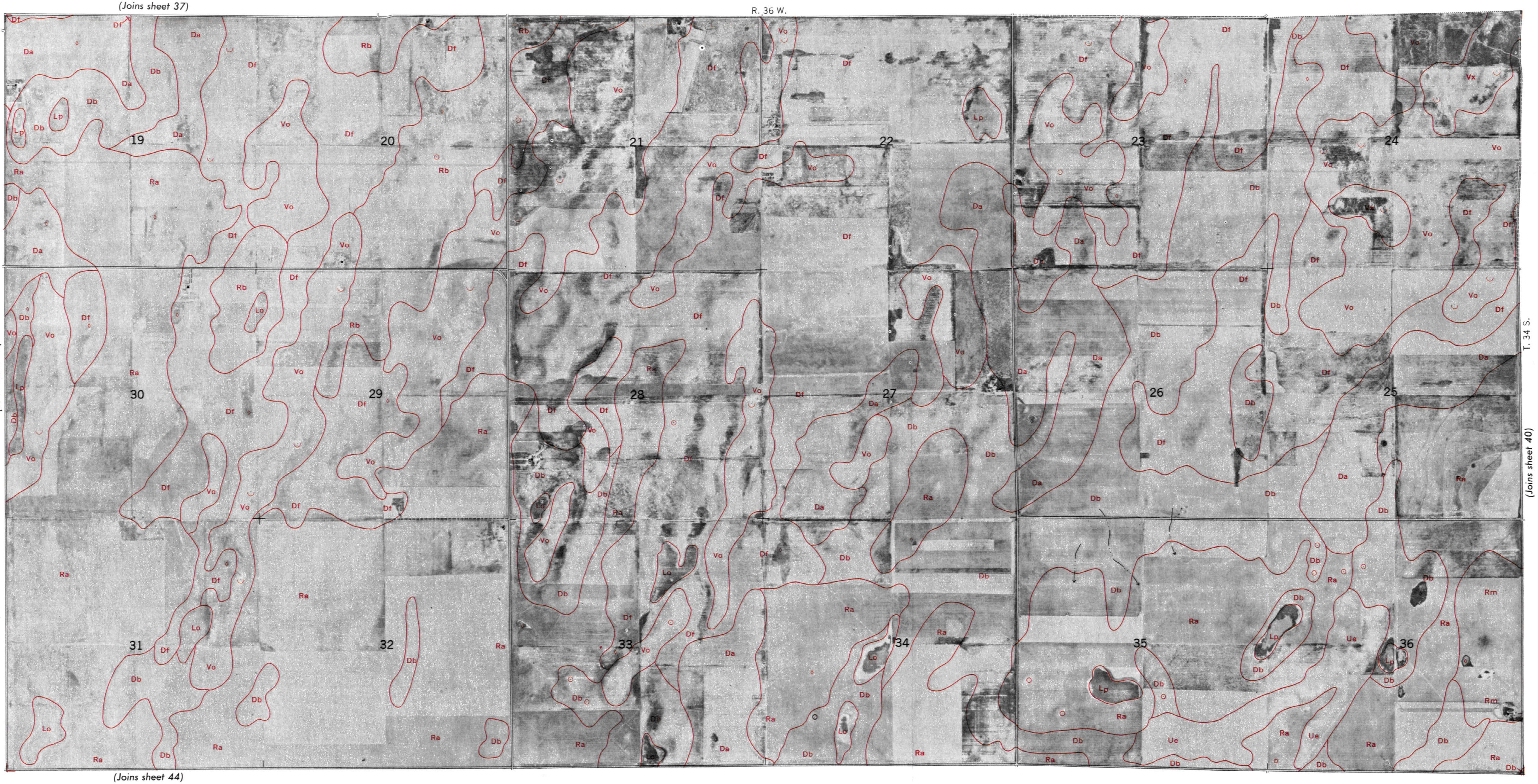


0 ½ 1 mile Scale 1:20 000 0 5000 feet

38

(Joins sheet 37)

(Joins sheet 36)



(Joins sheet 40)

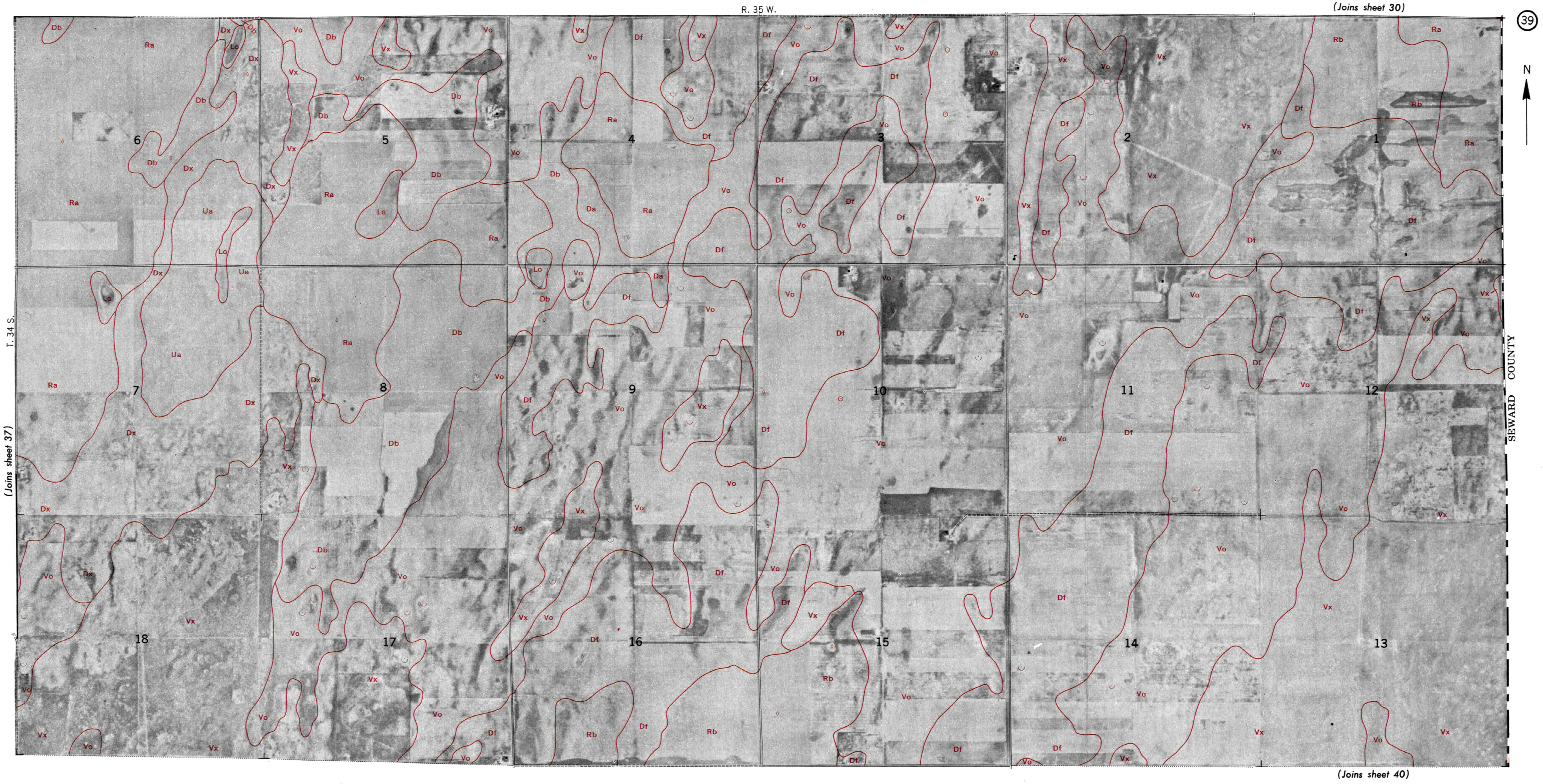
(Joins sheet 44)

0 ½ 1 mile

Scale 1:20 000

0 5000 feet

STEVENS COUNTY, KANSAS — SHEET NUMBER 39



0 ½ 1 mile Scale 1:20 000 0 5000 feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

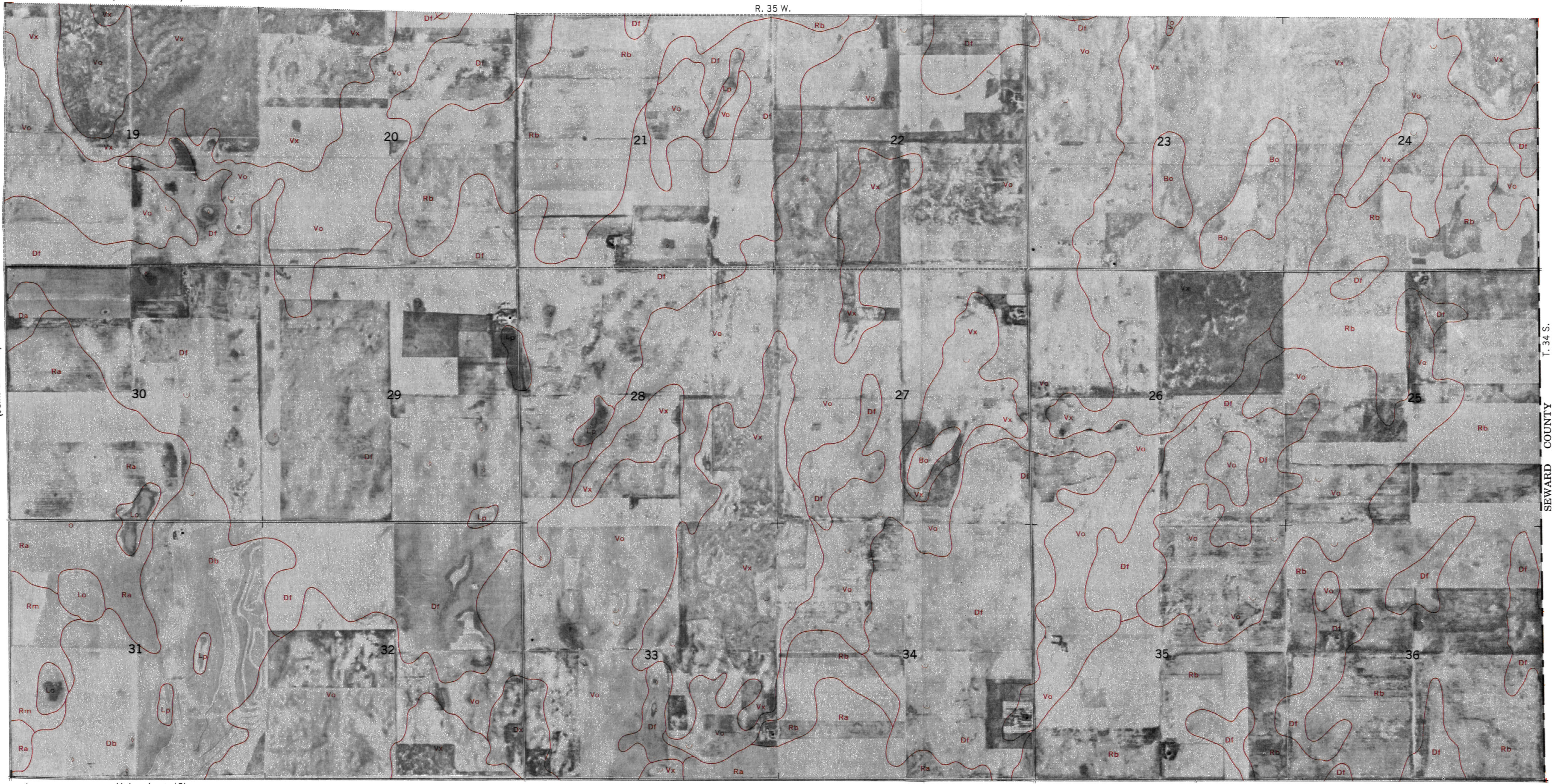
Range, township, and section corners shown on this map are indefinite.

STEVENS COUNTY, KANSAS — SHEET NUMBER 40

40

(Joins sheet 39)

N



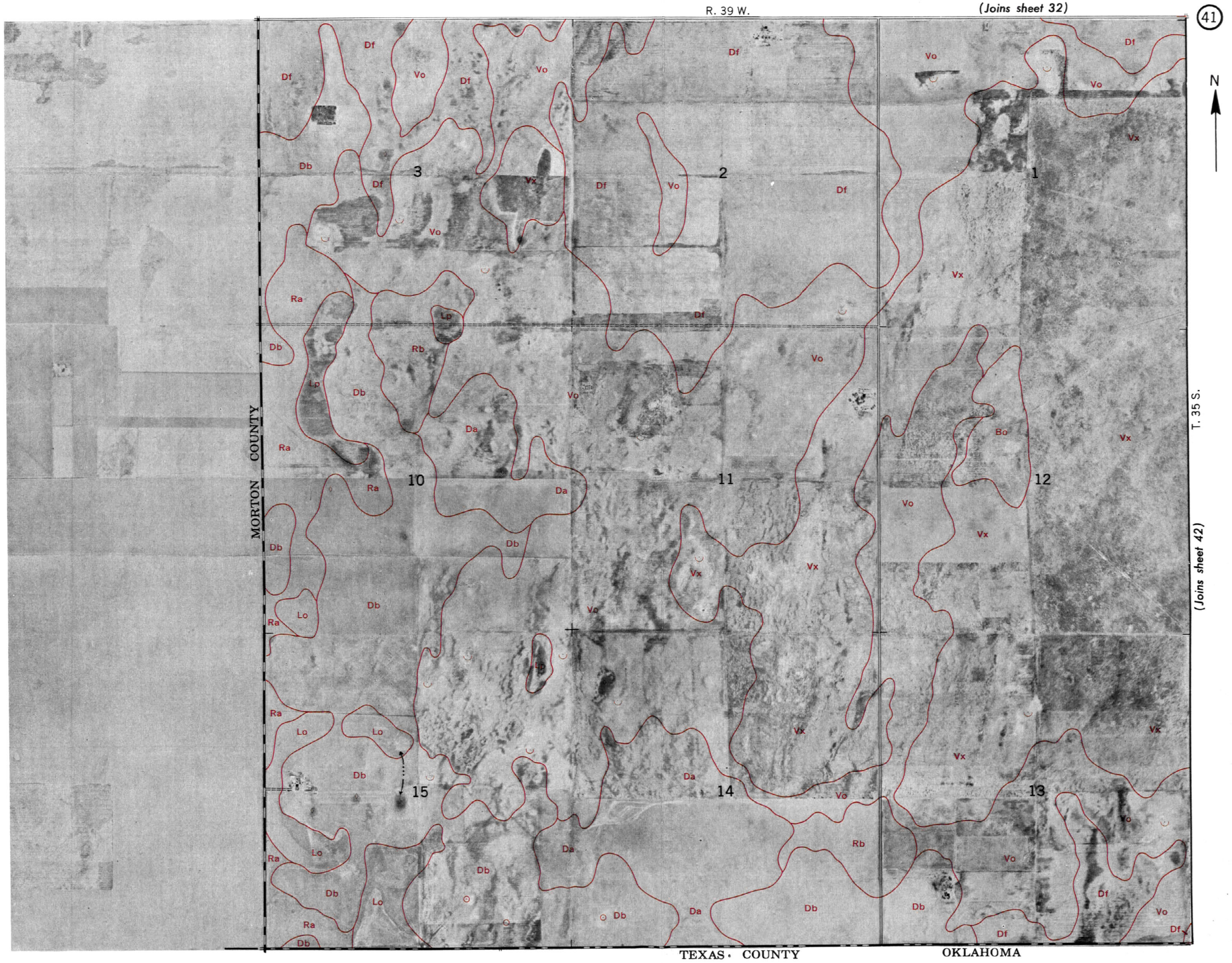
T. 34 S.

SEWARD COUNTY

(Joins sheet 38)

(Joins sheet 45)

0 ½ 1 mile Scale 1:20 000 0 5000 feet



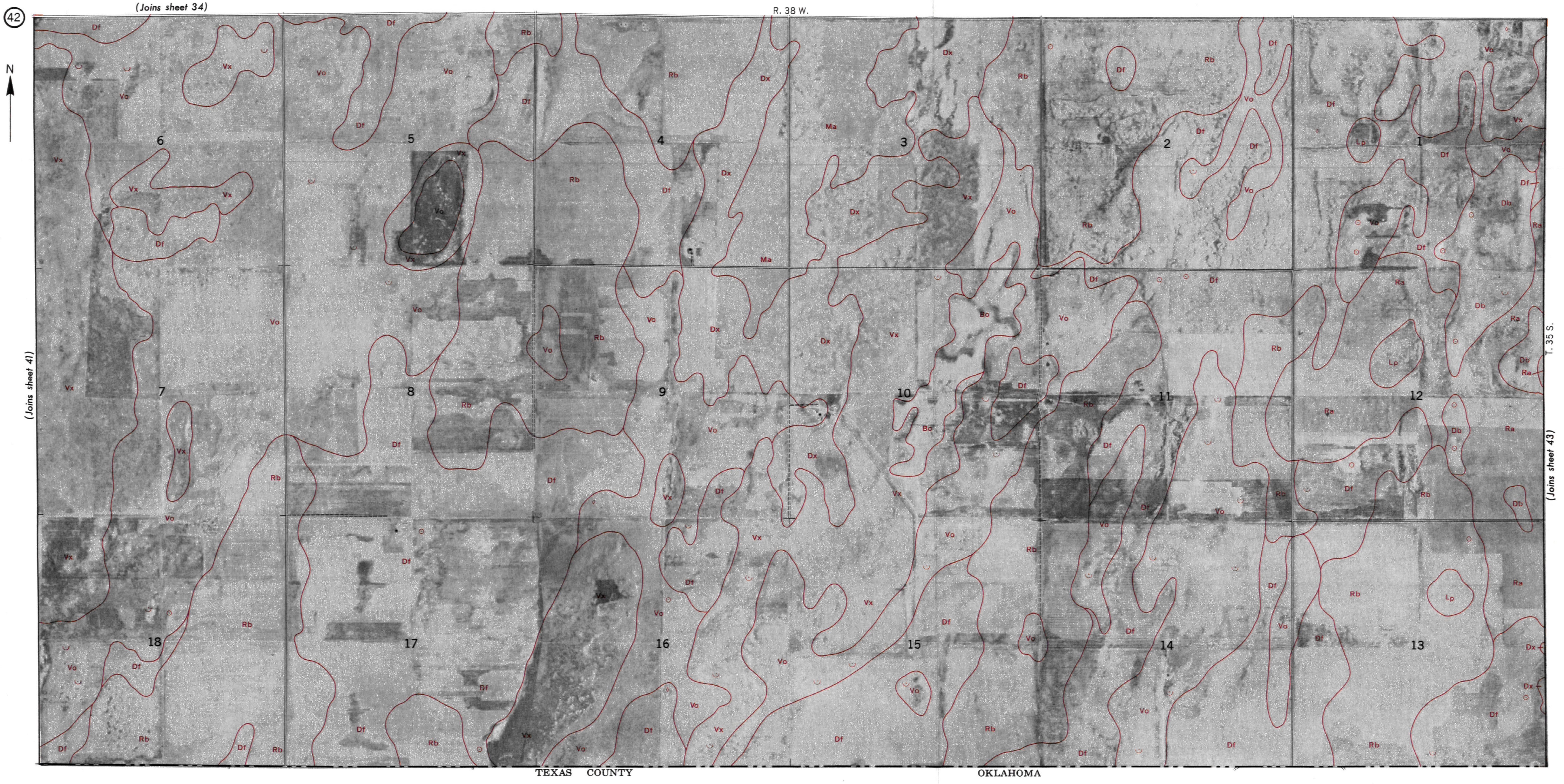
This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 mile

Scale 1:20 000

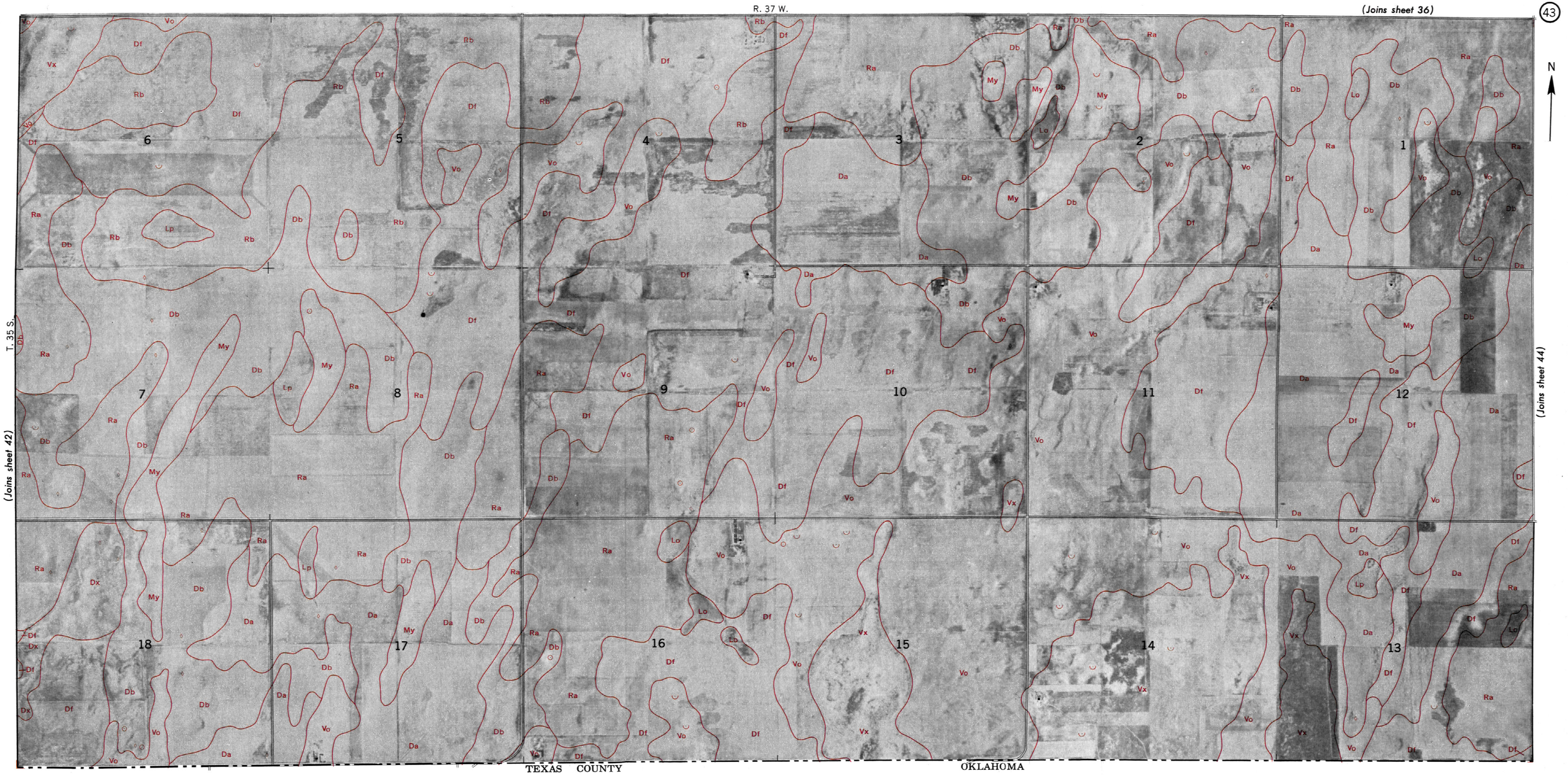
0 5000 feet



0 ½ 1 mile

Scale 1:20 000

0 5000 feet



0 ½ 1 mile

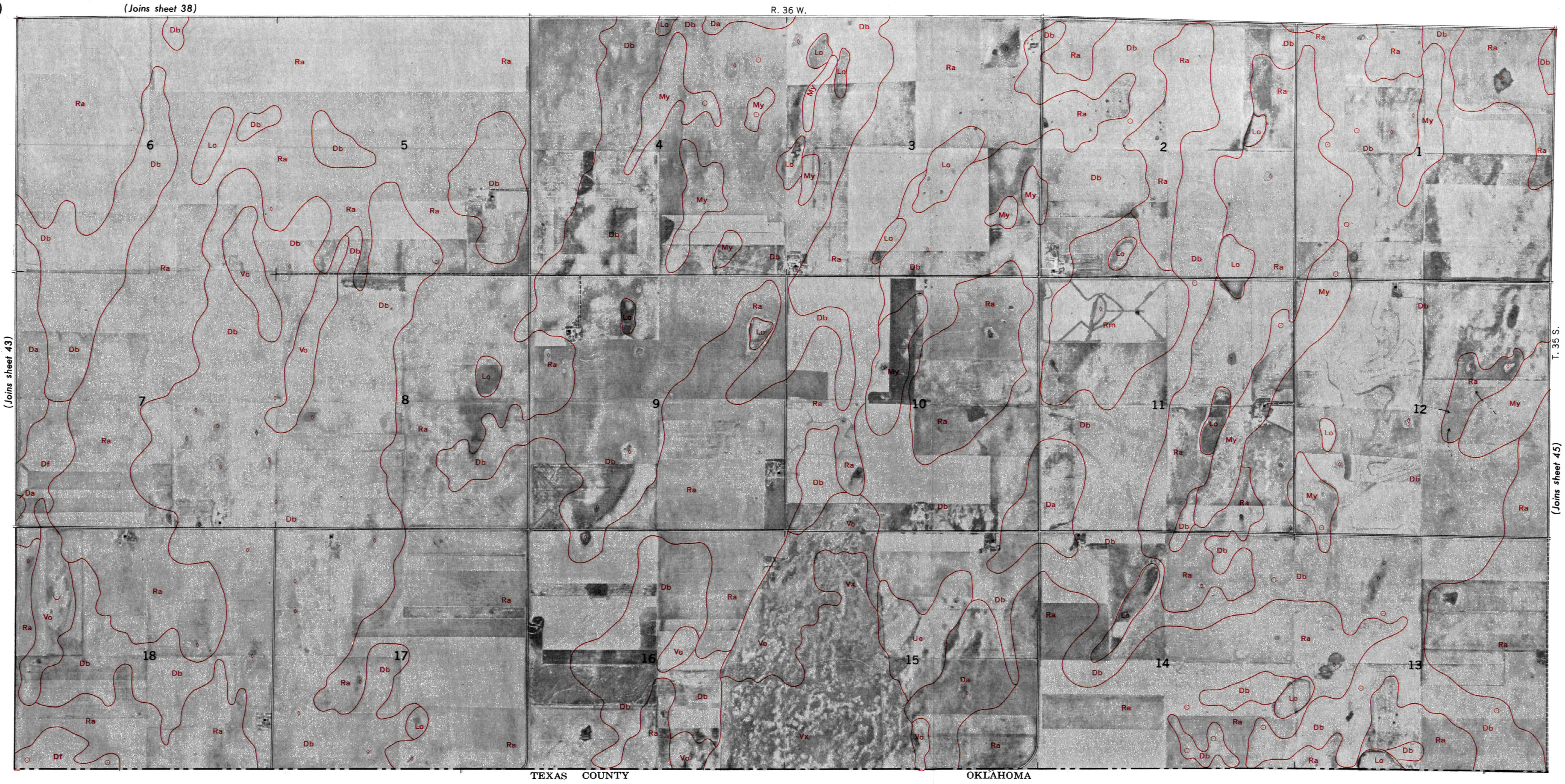
Scale 1:20000

0 5000 feet

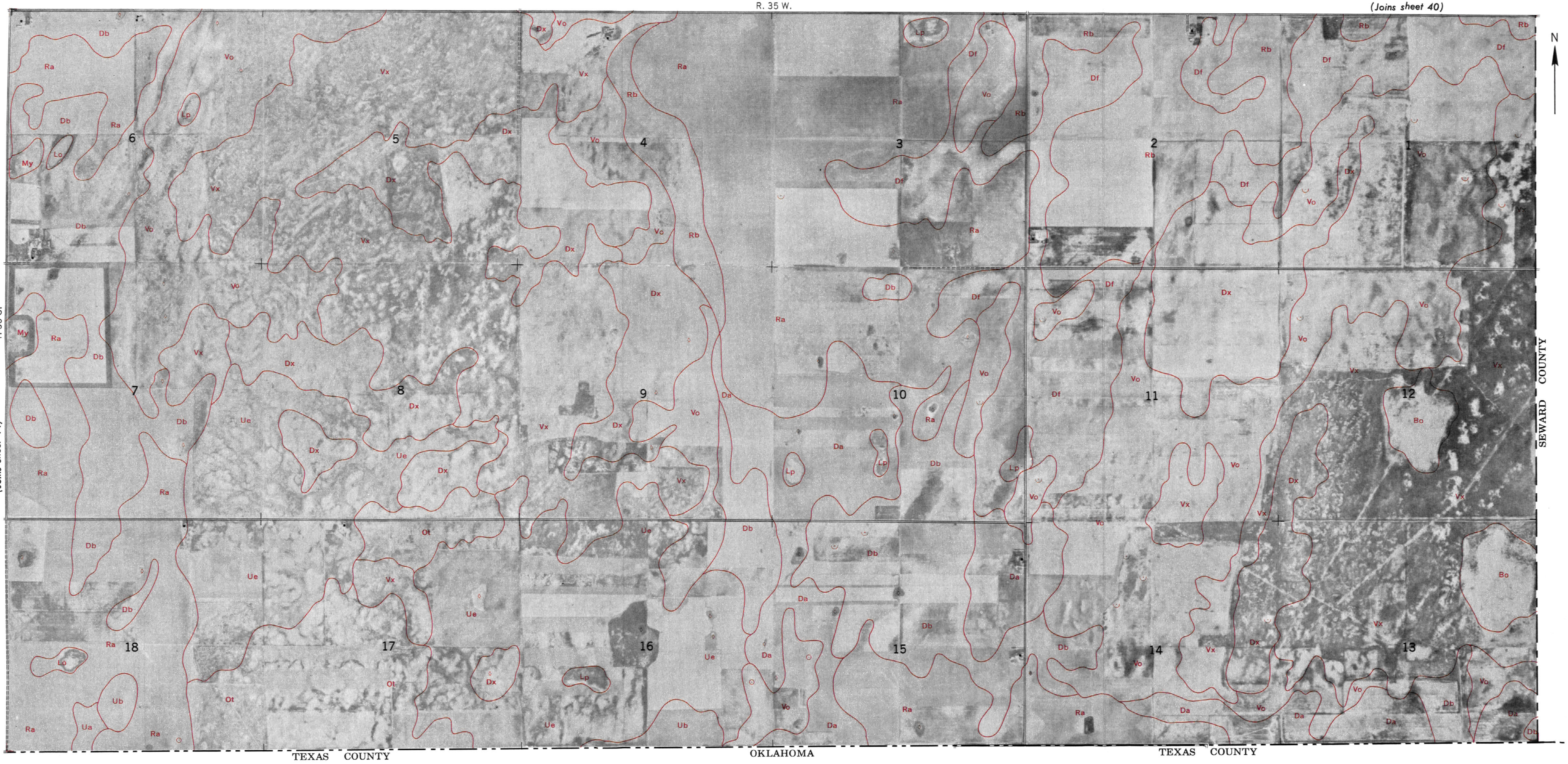
This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.

44



0 ½ 1 mile Scale 1:20 000 0 5000 feet



0 ½ 1 mile Scale 1:20000 0 5000 feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1953.

Range, township, and section corners shown on this map are indefinite.